New York Issue

Weatherwise

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"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE"—BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

DAVID M. LUDLUM, *Editor* HENRY W. BULKLEY, *Associate Editor*

A Public Weather Center for New York City

A UNIQUE opportunity to serve New York's educational needs in modern science is at hand. The old New York Meteorological Observatory in Central Park, founded by the city fathers in 1869, has recently been moved back into the focal point of local weather activity since it now serves as the base point for the city's daily and hourly climatological data. The almost-century-old records taken at a location nearly unchanged by nature has earned Central Park a key place in the newly-established network of benchmark weather stations where the Weather Bureau expects to maintain records permanently.

Here is a chance to establish a weather education center—where a working weather station of modern instruments could be maintained along with an exhibit hall showing the development of the science of meteorology and its importance in all aspects of modern atmospheric research and space exploration. Hundreds of school classes a year could integrate a visit here with their current science studies, and many residents and visitors of a scientific inclination would be drawn to such a feature.

By utilizing films, radio, and TV through educational outlets, courses of instruction could be brought directly to thousands of schools and to millions at home. When unusual weather conditions threaten or exist, special broadcasts explaining the developing situation together with up-to-the-minute reports would be of immense benefit to the health and economy of the city.

Why not a cooperative venture between the Park Department, the U. S. Weather Bureau, the nearby Museum of Natural History, and the Board of Education? The N. Y. Academy of Science and the American Meteorological Society could also lend assistance. The initial funds required to rehabilitate the Belvedere Tower are modest enough and the upkeep would be of small proportions when one considers the educational and material benefits to all.

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Front Cover: The lower Manhattan skyline as seen from ice-clogged Upper Bay on 3 February 1940, following very cold January. The Battery is at left foreground and old Staten Island ferry at right. Building at extreme left was location of Weather Bureau from 1911 to 1960. Wide World Photo.

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The New York Weather Bureau Office in Rockefeller Center

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Charles G. Knudsen, meteorologist in charge, seated, and Abraham S. Kussman, senior meteorologist, of the New York Weather Bureau Office in Rockefeller Center. Weather Bureau photo by Wendell Kilmer.

THE New York City Office of the U. S. Weather Bureau moved from its downtown location on 29 December 1960. It had been in the Whitehall Building at 17 Battery Place for almost half a century and in downtown Manhattan for no less than ninety years. Its history during this period is given in an accompanying article.

This recent move brought the office to modern and convenient quarters on the mezzanine floor of 30 Rockefeller Plaza, the address of the RCA Building in Rockefeller Center. Well known to tourists and visitors from all over the world, Rockefeller Center is located between 48th and 51st Streets and extends from Fifth Avenue to the Avenue of the Americas. The dome for the Weather Bureau's radar set now tops off the 850-ft. RCA Building, the highest of the sixteen buildings that make up the Center.

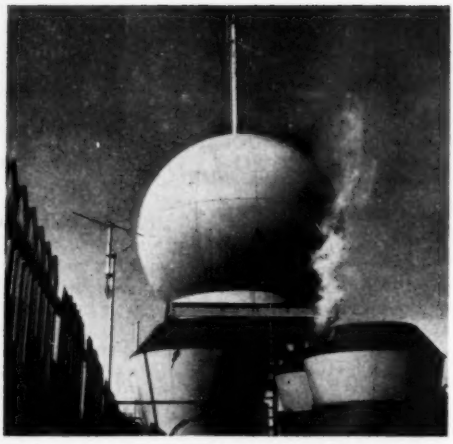
There is no doubt but that the move brought sighs of nostalgia to many old timers, but sentimentality has always had to give way to the demands of progress, especially in so demanding a field as the weather service. In recent years mid-Manhattan has more and more become the business center of the city. The new quarters are convenient to this concentration of commercial and industrial activity. In addition, Rockefeller Center is accessible from all parts of the city and suburbs by the network of transportation facilities that surrounds it. Finally, to touch on something important to the staff, the new quarters are well-appointed and have excellent heating and air conditioning facilities, as well as excellent lighting.

As one approaches the office along the mezzanine walk in the RCA Building, he is greeted by dioramas, set in the wall, that show various phases of meteorology. Radar storm detection is featured, for example, and there are striking depictions of such physical processes as the hydrologic cycle.

One first enters the reception and public room. This contains bookcases and files holding the complete local weather records, as well as extensive nationwide and foreign climatological data. Tables and chairs are set in this room for those who consult these data. In addition, the station library has the standard textbooks, a complete series of the *Monthly Weather Review*, and many years of *AMS Bulletins* and *Journals*. All these are in frequent use to help answer the questions received by telephone or asked by visitors to the office. The public room is also equipped with telephone wall installations, so that it can be converted into a briefing center for press, TV, and radio reporters during severe weather situations.

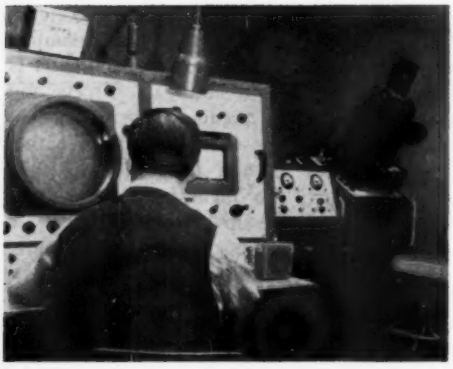
The visitor next passes into a side room where the marine unit is situated. The area climatologist is located here, too. This room gives access to a corridor, running across its rear. Turning to the left, the visitor reaches the radar, forecast, and communication rooms; to the right, the administrative offices.

The parabolic reflector of the storm detection radar rides hoist to the roof of the RCA building. Wide World photo.



The radar dome atop the 70-story RCA building is new center city landmark. Photo courtesy of *The New York Times.*

The interior of the radar dome with radar technician James Denaro at work. Photo courtesy of *The New York Times.*



Bert Weiner, radar meteorologist, at console of WSR-57 which has range of 285 miles. Radar photographic equipment at right contains polaroid at front and time lapse cameras on top. Weather Bureau photo by Wendell Kilmer.

The radar room, set in back of the public room, houses the console of the new WSR-57 radar set. With this are the components of the camera equipment, consisting of the Polaroid camera for instantaneous views of the repeater scope of the radar PPI scope and a 16 mm. motion picture camera with timing controls for time lapse films.

Adjacent to the radar room one discerns a small office set aside for broadcasting purposes and as a workshop for the station forecast development program. Continuing on into the forecast room, one enters a large, bright room utilized for forecasting, briefing, and observing. The striking feature of this room is the large picture window which extends practically the full length of the room. Here will be found three modern custom-built consoles that serve as work tables for the forecaster, briefer-observer, and climatologist. The forecasting console contains all the necessary weather charts, diagrams, and books required by the senior forecaster on duty. The briefer-observer console holds all the sequences and teletype data necessary to brief calls, prepare weather summaries, and weather maps for newspaper and wire services. The third console has all the equipment including observational data required to prepare the climatological records for the station.

In the large forecast room on the side wall are a series of instrument racks that contain the observatory dials and recording devices. This instrument rack is unique in that it presents mostly elements of weather being observed 1.5 miles uptown in Central Park at a site popularly known as Belvedere Tower. The elements that are being telemetered to Rockefeller Center from Central Park are temperature, dew point, wind direction, velocity, duration of sunshine, and amount and rate of precipitation. In addition, plans are in progress to transmit the solar radiation information as well as the previous mentioned elements. Aside from the remoted Central Park equipment, tidal information is relayed from the U. S. Coast and Geodetic tide gauge located at the Battery via telephone lines to a recorder located in the instrument rack. A mercurial barometer and micro-barograph round out the observational panel.

As one completes his visit to the bureau he next enters the communication and duplicating room. This space contains many teletypes including a local public teletypewriter circuit that serves the press, radio, television, industry, utilities, and civil defense. In addition, there are national weather teletypes, marine and hurricane circuits, radar warning circuit teletypes to the Coast Guard, and national facsimile machines. Besides teletypes, there are automatic answering telephones for

The main instrument panel contains—from left to right: mercurial barometer, microbarograph (top), tidal height recorder (below), telepsychrometer dials for current temperature and dew point (top), four-condition recorder for wind speed and direction, duration of sunshine, and precipitation (below), and solar intensity recorder at right. Weather Bureau photo by Wendell Kilmer.

the maritime industry, plus a teletype to the telephone girl who puts the latest forecast on tapes for the automatic public telephone—a number that has reached near a half million calls in twenty-four hours during severe weather periods, such as Hurricane DONNA and our recent severe snow storms of this past winter.

The New York Office is able to receive, with the use of teletypes and facsimile machines, all the local, national, and world-wide data for forecasting and briefing, and in turn, these machines facilitate the distribution of the office's forecasts, observations, and summaries with little lost time, disturbance, and a minimum of staffing.

The duplication section of the communication room contains a multilith unit, folding, and addressing machines that enable the office to print daily weather bulletins, charts, five-day forecasts, and daily weather records rapidly. Each weekday morning the seven o'clock data is assembled in a bulletin containing simplified maps; by nine-thirty it is available for distribution by messengers or mail. All daily records are also duplicated to expedite the many demands received for details of past weather. Since these are certified as correct they serve as valuable data for attorneys and individuals involved in legal questions.

The remainder of the New York Office space is the administrative section which includes the area for the meteorologist-in-charge, the secretarial and clerical staff.

Atop the RCA building over seventy stories above the street is the awe-inspiring plastic dome containing the twelve-foot parabolic antenna for the WSR-57 radar, and space is also available on the roof for related radar gear such as the modulating equipment.

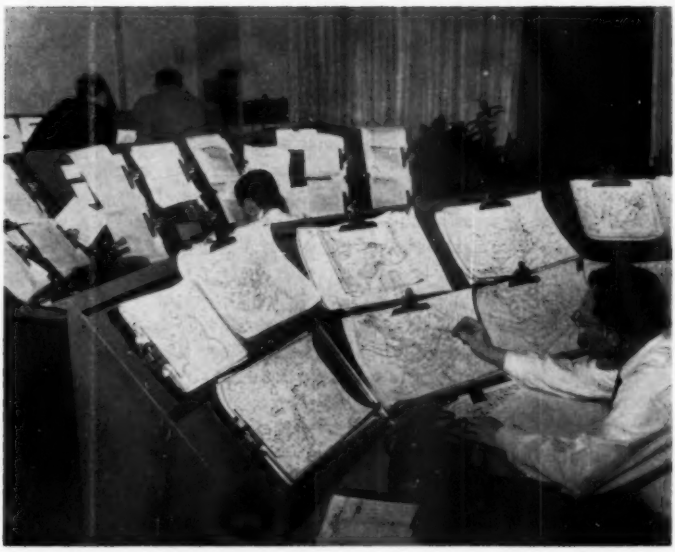
It is now possible to say, proudly, that the world's greatest city houses one of the most modern, fully-equipped weather offices, enabling it to serve efficiently the heavily populated metropolitan area of New York City and its surrounding suburbs.

How the New York Weather Bureau Serves the Public

THE New York office of the U. S. Weather Bureau, like many other such offices throughout the United States, has the responsibility of taking observations, recording, reporting, and forecasting the weather. Most of these weather observations are then transmitted to the National Meteorological Center near Washington where an expert staff plots and analyzes all the observations made on land, sea, and aloft. From these plotted maps and charts meteorologists forecast how the situation will change in two, three, or even five days hence. In recent years some of these charts of the upper-air circulation patterns have been analyzed and forecasts made automatically by high speed electronic computing machines. The use of electronic computers has permitted rapid solution of the hydrodynamic formulae now used for routinely preparing mean surface temperature prognoses.

The analyzed and prognostic charts are distributed to weather stations via a national facsimile circuit. These charts when received at the New York weather office are the basic tools used for making daily weather forecasts or storm advisories.

Let us now consider how the New York Office generally conducts its normal day-to-day operation.

The office is designed to serve the largest metropolitan area in the United States with a complete meteorological and climatological service program. This includes service for the general public, for the community of industry and commerce, to shipping on the high seas and inland waters, and for agriculture and recreation. The services for aviation weather are separate and handled by the

The forecast and briefing room shows forecaster Elias Morin at work with facsimile maps, while Stanley Addess studies current bulletins and data. Weather Bureau photo by Wendell Kilmer.

Weather Bureau Airport station at the New York International Airport for both domestic and international aviation.

The New York office is a state forecast center responsible for issuing daily public forecasts and severe weather warnings for an area exceeding 45,000 square miles with a population over 25 million people. The geographical area embraces eastern Pennsylvania, southeastern New York including New York City, Long Island, Westchester and Rockland Counties, along with Connecticut and New Jersey.

The office also prepares and issues marine forecasts for the inland and immediate shore waters out to fifty miles from Cape May to Block Island. The public forecasts are issued four times daily and for 24 to 48 hours in advance. Each day outlooks of weather are also issued for four to five days in advance.

Special forecasts and warnings are of many different types: special agricultural advices for northern New Jersey and Long Island, forecasts of flood waters caused by abnormal high tidal surges, and warnings relative to severe storms such as hurricanes, severe thunderstorms, heavy snowstorms, tornadoes, and high winds.

To accomplish this day-to-day routine, a staff of competent meteorologists are on duty twenty-four hours a day, seven days a week. The senior meteorologists assigned to the staff are well qualified in experience and professional education with an average time in service of approximately twenty years. The assistant forecasters or meteorologists have many years of experience and are fully trained through formal courses in meteorology.

The basic forecasting material consists of analyzed surface and upper-air maps, as well as many auxiliary working charts transmitted to the office from the National Meteorological Center. In addition, a few auxiliary forecast charts or diagrams are plotted by the local staff. The New York office is unique in that over the past decade it has developed a Forecast Development Program, initiated to formulate objective techniques to assist the staff in preparing its daily forecasts.

These methods are now fairly well established so that they may be incorporated into the daily routine of the forecaster. Research is also carried on that enables the staff to post-analyze situations in the hope of improving some of the systems. These objective techniques are varied, ranging from methods of forecasting motion and intensity changes of lows and highs, to techniques that assist the forecaster in determining maximum and minimum temperatures for one to three days

in advance, ways of calculating or determining whether it is going to snow or rain, or methods of typing and classifying surface and upper-air charts. These techniques in some cases are methods developed by members of the local forecasting staff, but many have been based on outside research groups employing principles of empiricism, statistics, and kinematic processes. The objective techniques have been catalogued for easy reference and can be readily calculated with little loss of time by the experienced meteorologist. In addition, guidance forecasts and prognoses are available from the National Meteorological Center so that the staff forecaster can check his own prognostic chart developed by the aforementioned objective techniques.

When all the forecasts for the area are completed, another stage of operation has been reached, that of distribution. The office depends on the following facilities of communication: press wire services, radio, television, newspapers, automatic telephone and telegrams to planned lists depending on type of forecast. In the event of extreme emergency, a network of radio stations is organized for immediate use with direct broadcasts from the office, and an organizational plan is ready for use of "CONELRAD" if emergency is such as to threaten life or considerable property damage.

At this point it may be interesting to note that the annual volume of such communication is immense for the entire weather bureau. Our five million weather broadcasts are made over radio, television stations, and over 200 million automatic telephone calls nationally. Just this past January in New York on the average business day, calls over the automatic phone averaged 133,000. There were two periods of thirty-six hour duration when the calls exceeded a half-million.

The manner in which these communication services receive these calls is quick and efficient. The use of a public teletypewriter circuit is also an important phase of New York's communication method. It is operated at no cost to the government. The subscribers on this circuit receive all the necessary data, such as observations, weather summaries and forecasts—all transmitted regularly throughout the day.

It is important to stress that the New York City Office, like all other Weather Bureau offices issuing public forecasts and warnings, is providing a service of great value to numerous segments of the public. Perhaps one of the most dramatic examples of this is the case of the heavy snow forecast with its far-reaching implications to transportation, farm operations, recreation activities and the public in general.

Now let us consider the phase of work that follows after observations have been recorded and forecasts filed. These past weather records are maintained in comprehensive form in the public room of the New York office. They become a great aid to many phases of community problems, aiding in community plans, industrial and commercial management, court cases and insurance claims, just to name a few.

The public room records are complete, including all the office daily records for the Battery and the Central Park Observatory. In addition to these, weekly, monthly and yearly records of all Weather Bureau offices and state, national, and world figures are maintained. The requests for climatological information are many and varied. So many large organizations have their headquarters in New York, and the scope of their activities is so large, that the staff has to be prepared to handle questions ranging from average rainfall in India for an engineering concern designing a dam there, to temperatures in the Midwest for an advertising firm concerned with proper timing of a sales campaign for a new product. When the information is not in the office files, the caller is referred to another source.

The New York Office has a marine section that exercises administrative supervision of marine weather reporting services for the western North Atlantic from San Juan, Puerto Rico, to Eastport, Maine. The marine unit enlists the cooperation of commercial and government vessels in a weather observation program.

The Northeast Area Climatologist is based at the New York Office. He is responsible for the development of the program laid down by the Director of the Office of Climatology for meeting the climatological needs of the twelve northeastern states, and to accomplish this gives technical guidance to the several

State Climatologists and works on regional problems affecting agricultural and other interests in the area.

Finally, the day-to-day dependence on adequate weather forecasts and services in an area where so many people reside and do business is such that a recent survey revealed as many as 50,000 contacts per month were made. Many business firms have organized definite programs for keeping in step with weather changes as indicated in the forecasts and formulate their plans accordingly; for instance, shipping companies employ stevedores for loading and unloading at certain times in the afternoon for work to be accomplished the next day; if rain develops the stevedores are unable to work, but they still are remunerated: hence, thousands of dollars are lost to the company. A baking firm depends upon weather advice prior to selling the baking schedule for the next day; and retail stores estimate the volume of trade by the weather which seems likely.

Of course, no specialized forecasts are issued to these interests, and in cases where a study of their operations and "tailor-made" forecasts are required to fill their weather needs, they are advised to engage a professional meteorologist.

The large congregation of people in the New York Metropolitan area leaves it particularly vulnerable to the threat of disaster should a violent storm strike without warning. A heavy snowstorm, in particular, presents a gigantic problem to the travelling public, transportation companies, and the city departments charged with keeping streets and highways open to traffic. The recent heavy snowstorm in New York on 3–4 February 1961 well exemplifies this situation. Mayor Wagner was forced to place a ban on driving of private automobiles in Manhattan for several days to enable the Sanitation Department to clear the streets with a minimum of hindrance. A few days later just one advice to city authorities that a threatening snow might be light or not even reach the city saved an estimate $50,000 through withholding the order that would have started the first fleet of trucks and workers to their posts.

It is readily apparent from the above that the work of the New York Weather Bureau Office is broad: from assisting the individual through the public forecasts to plan his daily activities intelligently, it ranges to the issue of detailed advice required for the protection of lives and property and for the well-being of the entire community.

The Public Room contains files of New York City and United States climatological data. Northeast Area Climatologist, James K. McGuire, left, is preparing a Government report, while private consultant Walter Zeltman of the International Weather Corporation, also of 30 Rockefeller Plaza, is compiling data for a client. Weather Bureau photo by Wendell Kilmer.

History of the Weather Bureau Office in New York City

JAMES K. MCGUIRE, *Northeast Area Climatologist, Weather Bureau Office, New York City*

ONE of the many items transferred from Battery Place to Rockefeller Center was a set of old ledger books, that had accompanied the office on each of its previous changes of location. The first book in the set is headed, "Daily Journal, U. S. Signal Office, New York City," and the opening entry reads as follows:

> November 1st 1870. First day of observations and reports. Reports came promptly with the exception of Key West which was not received at all owing to broken cable.
>
> Instruments of this station all in good working order and observations were made promptly. Morning cloudless, but somewhat hazy. Cirrus clouds appeared toward evening. At midnight sky was very clear. Barometer nearly stationary. Wind light all day.

New York's official wind instruments top the 60-foot Belvedere Tower on west side of Central Park near the 79–81st Street Transverse Road. Instruments are 194 feet above sea level.

So the Weather Bureau office in New York City began its career, under favorable atmospheric auspices and with everything in good order except for the Key West report. The station had been opened six days before, with Sergeant C. R. Estabrook in charge. It was one of the first to be established after the national weather service was authorized and assigned to the U. S. Army Signal Service by joint congressional resolution approved on 9 February 1870. The location of the office was the Board of Underwriters Building at 49 Wall Street, in the heart of the financial and commercial section of the city. For ninety years, the office was to remain in this locality, at the tip of Manhattan Island, where the original Dutch settlement of New Amsterdam had been made.

The 49 Wall Street location was short-lived, less than seven months. On 29 May 1871, new quarters were opened in the Equitable Life Insurance Building, 120 Broadway, one block north of the corner of Wall Street. This was about 2000 ft. northwest of the Board of Underwriters site. The office remained in the Equitable Building until 15 March 1895, when two changes took place in relatively quick succession. It was first removed to the Manhattan Life Insurance Building, 66 Broadway, and then, on 16 October 1898 to the American Surety Building at 100 Broadway. These were small changes, just up and down the street, and the office settled down until 1 May 1911. On this date it was relocated in the Whitehall Building, 17 Battery Place, about one-half mile southwest of its former locations. There it remained until the "big move uptown" occurred at the end of 1960.

The foregoing would be inadequate unless mention were made of some of the personalities associated with the office during the ninety-year period involved. These were of

course military men until 1890, when the weather service was transferred to the civilian Weather Bureau. C. R. Estabrook, who opened the station, was succeeded by a number of sergeants-in-charge (an odd title for weathermen!). They commanded a small staff, and frequently had their troubles in keeping the office operating. We can read between the neatly penned lines in the *Daily Journal* for January 1883, and sympathize with Sergeant John B. Merrill's difficulties:

> Private Wm. L. Nidmeyer taken sick; granted indefinite sick certificate. . . . Telegraphed facts to the Chief Signal Officer requesting assistance. Station duties much embarrassed. Office full of reporters. . . .

Two days later, he wrote:

> Station force completely fagged out by reason of the extra exertions made to keep up the station work without additional expense since the illness of Pvte. Nidmeyer.

Fortunately, on the same day Merrill was authorized to hire an emergency civilian assistant—at $3 per day—and this particular crisis was overcome.

The greatest test to which the office was placed in the Signal Service days was undoubtedly the Blizzard of '88. This famous event is now remote and almost legendary, but the account in the *Daily Journal* succeeds amazingly well in conveying what the storm was really like, because of its matter-of-fact style and absence of exaggeration. Gale force winds and snow began on the early morning of March 12th; it was soon practically impossible to move outdoors in the near-zero cold and near-hurricane blasts which piled the snow at some points in the city "to an elevation of 15 or 20 feet." When the blizzard ended on the following day, "many persons were found frozen" in the streets. With good reason the *Daily Journal* included this paragraph:

> The assistants on duty at this office are deserving of the greatest praise for their promptness and most willing efforts under such trying circumstances to keep the instruments in proper working order and all the routine duties both in and out of the office, reflects credit upon their courage. While in almost every case, business was suspended owing to failure of employees to appear, not a man was absent at this office and all reached here at the peril of their lives.

The man who wrote these words was Sergeant E. B. Dunn, who had entered the service in 1874 as a private, assigned to the lowly detail of printing the daily weather bulletin, and had worked his way up to become head of the office in October 1886. He remained as official-in-charge after the changeover to the civilian Weather Bureau, and served in this capacity until July 1898. Popularly known as "Farmer" Dunn, he was one of the famous figures in New York before the turn of the century.

Equally well known was James H. Scarr, official-in-charge from October 1909 until his death in February 1936. Over this twenty-seven-year span, Scarr built up an immense local reputation. To anticipate a bit, it is noteworthy that Scarr was long dissatisfied with observations taken atop tall office buildings, and conceived the plan of having satellite observing stations set up in the parks in the five boroughs of the city. His successor was his long-time associate, James H. Kimball, a pioneer in forecasting trans-Atlantic weather conditions. It was to this New York City weatherman that Lindbergh, Chamber-

New York's official temperature and humidity exposure shows shelter with thermometers and hygrothermograph and aluminum housing of aspirated telepsychrometer. Instruments are six feet above ground and 138 feet above sea level.

lain, Byrd, and other aviators turned in those exciting days when flying to Europe was a hazardous undertaking.

The rise of aviation had been responsible for the establishment of the Weather Bureau station at Newark Field, in nearby New Jersey, on 14 March 1929. The next steps were the opening of the stations at La Guardia Field on 7 October 1939, and at N. Y. International Airport on 15 June 1948. These offices handle the forecasting needs of the vast volume of air traffic that flies in and out of the metropolitan area.

Linked with the recent move of the city office to Rockefeller Plaza was the establishment of the Central Park Observatory as the official observing point for the New York City climatological records. This circumstance refers back to another phase of the weather history of the city, antedating even the Signal Service.

New York's weather had been recorded as far back as 1788, when Henry Laight began temperature observations and continued them until 1836. His precipitation record started in 1806. He usually took his observations three times a day, at his home, for the use of the New York Insurance Company. A similar series was that made by S. J. Warring, for the Atlantic Insurance Company, over the years 1824 to 1835.

At Fort Columbus, on Governors Island just off the tip of Manhattan, the Medical Department of the U. S. Army took weather observations from 1821 until 1890. Observations were also taken at Fort Hamilton in Brooklyn, on the shore of the Narrows, for a good part of the same period. Another outstanding group of weather records are those made under the auspices of the State of New York, through its school system. The New York Academy stations included three in New York City: Erasmus Hall in Brooklyn (climatological records from 1826 to 1873), Union Hall in Queens (1826–1864), and the Institute for the Deaf and Dumb (1843–1873). In addition, a famous name in the development of American meteorology, William C. Redfield, took observations in New York City from 1831 until his death in 1857.

In sum, there was considerable practical interest in the weather long before the Signal Service office was opened. A reflection of this interest was the action of the Chamber of Commerce in 1857, urging the establishment of an observatory for chronometric purposes and for reporting on the weather. Undoubtedly due to the Civil War, nothing happened until 1869. On May 5th of that year, the Board of Commissioners of Central Park were authorized by the State legislature to operate a meteorological observatory. This had actually been started about the end of the previous year, in the Arsenal Building on the east side of the park at Fifth Avenue and 63–64th Streets.

The first and only director of the New York Meteorological Observatory (better known as the Central Park Observatory) was Daniel Draper, who served for no less a span than forty-three years. Draper acquired an international reputation by developing an outstanding observatory and by inventing several automatic recording weather instruments, some of which were still in service many years after his death. The Central Park Observatory issued complete monthly and annual reports, and exchanged them with the publications of learned societies throughout the world.

Upon Draper's retirement in 1911, the municipal authorities approached the Weather Bureau with the idea of continuing the Observatory on a cooperative basis. James Scarr welcomed the opportunity, and an agreement was reached and is still in effect whereby the City of New York is responsible for the maintenance of the Central Park Observatory, the Bureau for the instrumental equipment and operating personnel. On 1 January 1920, the Observatory was moved about one mile to the north, to the picturesque Belvedere Tower. This is set on a 132-foot hill, the highest land in the park, on its western side near the 79–81st Street Transverse Road. The grey stone structure rises to a height of sixty feet, and stands out like a miniature castle above the surrounding lawns, lakes, and trees. The instrument shelter and hygrothermometer are set in a nearby ground enclosure. Temperature, dew point, wind, sunshine, and precipitation readings are remoted to 30 Rockefeller Plaza. This arrangement preserves one of the few climatological series of long standing and

(Continued on page 71)

How Private Meteorology Serves New York

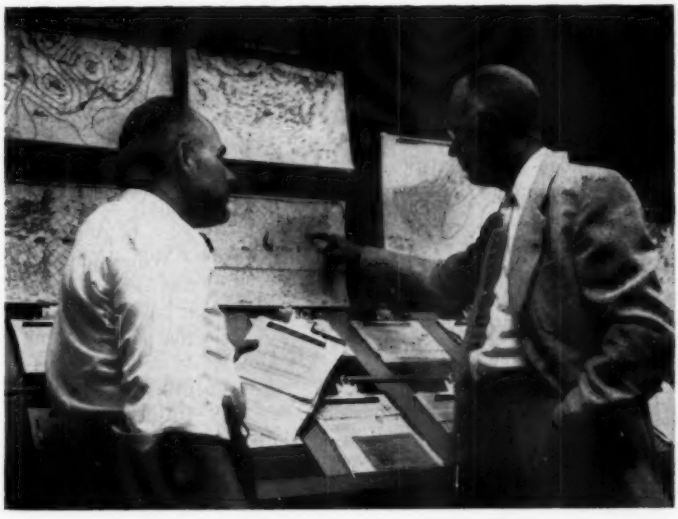
All private meteorological companies which are listed in the AMS professional directory as maintaining an office in the New York area were asked to contribute brief accounts as to how they serve the New York public.

National Weather Forecasting Corporation

The establishment of National Weather Forecasting Corporation at Newark Airport in June 1957 was the "dream come true" of a professional pilot, the late Brigadier General Harry R. Van Liew USMCR. Twenty-five years of flying gave General Van Liew the insight into the potentialities of applied meteorology that few individuals possess. Norman "Bud" Lacey, former TWA meteorologist, now occupies the presidential chair, and the staff has grown from two to seven full time forecasters.

The progress of aviation and the advancement of meteorology have been closely intertwined since the Wright Brothers flew at Kitty Hawk. The growth of business and executive flying during the past decade has created an increasing demand for specialized weather information. Operating in the main to and from the smaller airports in the metropolitan centers and the many airports where no scheduled airline service exists, business and executive pilots find that many decisions they are called on to make involving safety, passenger convenience, intricate scheduling, and maintenance, to mention a few, leave little time for comprehensive analysis of flight weather. The luxury of a slow, careful one-hour study of weather charts and sequences prior to each flight is just not practical except in rare instances. A professional meteorologist, who can combine forecasting techniques with a working knowledge of flight operations, can be invaluable to the success of these operations.

Very shortly other forecasting applications were brought into play. The forecasting criteria for aviation requires a nearly complete atmospheric analysis within the normal operating range of modern aircraft. With this broad and comprehensive analysis, you automatically have established the ground work for the application of your forecasting skill to other problems such as local and specific forecasts of such elements as time, type, and amount of rainfall or snowfall;



President Norman Lacey in shirtsleeves briefs private pilot at National Weather Forecasting office, Newark Airport.

temperature range, amount of sunshine, local winds, humidity, and other elements. National Weather thus began to forecast additionally for such earth-bound endeavors as building construction, commercial photography, highway maintenance, department store advertising, baking, and commercial fishing. In the more recent years, research and direct consultation work have been added to the agenda as staff and facilities have increased so that at the present time National Weather Forecasting Corp. offers a full range of professional services in meteorology.

Special forecasting for aviation or industry requires careful investigation of the particular operation before any forecasting can begin. The ground work which precedes the required forecasting must be handled by a specialist who can adapt the limits of forecasting ability to the needs of the client. Often as not, we, at National Weather, find that *both* the client and the forecaster learn invaluable information from such preliminary studies.

Every weather problem which National Weather is called to work on has its own element of interest and provides new horizons for the meteorologists' talents. There are always a few, however, that because of some unusual requirement provides something "extra" which makes them more interesting to those who are unfamiliar with the problem.

In the past year we have provided humidity forecasts for a large shipbuilding company that wanted to spray paint the interior of a ship without air conditioning the entire vessel for the purpose. We have provided daily forecasts for a major league baseball team so that they could cover or uncover the playing field efficiently. And we have supplied weekend forecasts for a large baking concern which had to judge the quantities of baked goods that were shipped on Thursday for weekend consumption.

We at National Weather Forecasting find that only the surface has been scratched in the important field of private meteorology and what lies under the surface will provide an exciting and fruitful future.

JOHN A. WOOLLEY
Vice President, Operations
National Weather Forecasting Corp.
Newark Airport
Newark, New Jersey

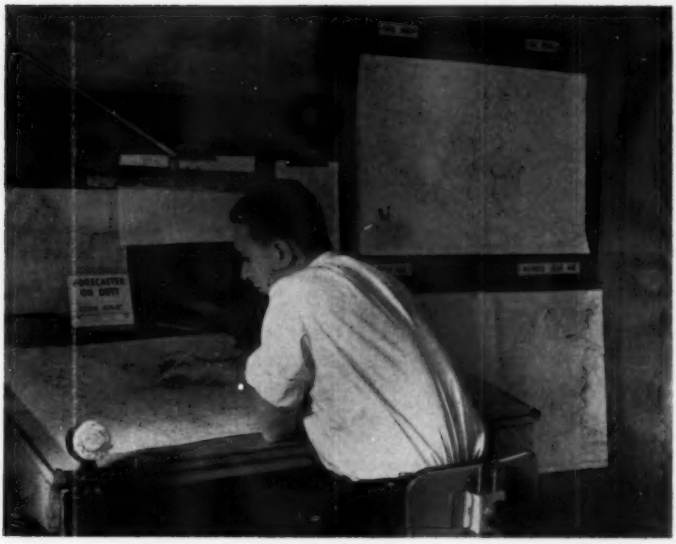
Northeast Weather Service

Northeast Weather Service was established in Boston, Massachusetts, in 1946. The office was moved to the Terminal Building, Hanscom Field, Bedford, Massachusetts, in 1956. A branch office was opened at Westchester County Airport, White Plains, New York, during the early fall of 1957.

From its very beginning Northeast has specialized in serving utility companies and various highway departments within the New York Metropolitan area. There are probably very few people who live or commute to Manhattan who are not directly or indirectly affected in some manner by the services of Northeast to its numerous clients within the area. During the winter months it is our responsibility to forewarn most all of the parkways, thruways, state, and municipal highway departments of storms that are expected to present maintenance problems. With adequate advance notice of snow and ice storms, in most instances, the various highway crews are able to stay ahead of these storms, and thus avoid major traffic tie-ups. It is also Northeast's responsibility to see that these highway crews are not called out until they are actually needed by preparing precision-type forecasts of the time of beginning of these storms.

For many years Northeast has been serving the principal utility companies supplying the New York area with gas and electricity. Given accurate temperature and wind forecasts, the gas dispatcher can quite accurately predict the demands upon his system. While a two or three degree change in temperature is hardly noticeable to the public as a whole, such a change without prior notice can become quite critical to the gas utility. For each degree of temperature change is immediately noticeable in the amount of gas that must be provided for space heating.

While temperature and wind information has always been important to the gas utility, it has only been during the past several years that this information, in addition to humidity information, has become vital to the electric utilities operating in the New York area. Until recently peak loads were always established with the electric utility during the Christmas season, and were always more or less predictable from past experience. But



Forecaster Connie Gosset analyzes map at office of Northeast Weather Service, Westchester County Airport, White Plains.

with air-conditioning saturating the area during the post-war period, peak loads now occur any time during the warm months and are not predictable without accurate forecasts of the temperatures and humidities that can be expected, for the air-conditioning load is also a function of these weather elements. In fact, accurate weather information is now even more critical to the electric dispatcher than to the gas dispatcher for the gas utility has some storage to use as an immediate cushion. The electric dispatcher has no storage and must be ready to meet all system requirements at a moments notice.

A third specialized service offered by Northeast in the New York City area is personalized flight forecasts for corporation aircraft. Privately owned aircraft now far outnumber commercial aircraft operating within the United States. Many of these corporation flight facilities desire more personalized services and weather information than is possible to obtain from the public weather service. Northeast set up a special unit to service these subscribers at the Westchester County Airport. Flight forecasts are prepared especially for individual trips which assures the client the very latest in weather information. Another valuable feature of this service is Northeast's policy of following up each forecast and notifying the client immediately upon the detection of any change in forecasted weather conditions.

JOHN E. WALLACE
President, Northeast Weather Service
Westchester County Airport
White Plains, New York

Weather Trends, Inc.

Weather Trends, Inc. was organized in 1954 to provide long range weather advisories to the many farmers and small business firms who are dependent upon weather but could not afford the fees of existing services. Although individualized and interpretative reports are still prepared for a number of large companies in air conditioning, retailing, construction, etc., a high percentage of our efforts is directed towards a monthly weather *Bulletin* which we sell on individual subscription. Subscribers come from every part of the United States and Canada. Every conceivable industry and profession is represented but the majority are engaged in some phase of agriculture.

The Weather Trends Bulletin is also sold in large quantities for use in promotional mailings. Most clients who sponsor such national mailings include an advertisement or selling message and they have found that weather is of such universal interest that readership is much higher than other forms

of direct mail. A second promotional service, in the form of a weather calendar, is used primarily for regional mailings.

In the field of applied climatology, Weather Trends specializes in weather marketing studies, or the affect of various weather elements on the sale of a weather-sensitive product. Examples of this type of work include:

a) A climatological map showing timing of first topcoat weather.

b) Relationship studies between weather and the incidence of poison ivy and hay fever.

c) An annual evaluation study showing the affect of weather on air conditioner sales during the previous season.

BARRY SCHILIT
Weather Trends, Inc.
550 Fifth Avenue
New York 36, New York

American Airlines Serves Its New York Public

THE early recognition that efficient airlines operations required accurate weather information, readily available to pilots and dispatchers, caused the original American Airways, Inc. to establish a weather station at Newark Airport in 1931. Staffed by Navy or university trained professional meteorologists, the Newark station became the key to the further expansion of the service when American Airlines was organized in 1934. At various times weather stations have been maintained in a dozen North American airports. With the opening of La Guardia Airport in 1939, the original weather station was transferred there, and in 1960 to new quarters at New York International Airport.

Area forecaster Irwin Roth at new American Airlines weather office briefs Flagship Captain while other pilots study data.

Our weather organization has changed and expanded until today it is one of the largest, if not the largest, private meteorological organization in the country. And since the practice of private meteorology is frowned upon in most other countries throughout the world, it is probably safe to say that it is the largest such organization in the world. American's staff now consists of 48 professional meteorologists and 5 assistants who provide round-the-clock weather forecasting service and advice for the far-flung flying and ground operations that extend from coast-to-coast and from Mexico to Canada. These meteorologists are located at four key dispatch and weather bases on the system, 20 at Idlewild Airport in New York, 11 at Midway Airport, 10 at Amon Carter Field in Fort Worth, and 7 at Los Angeles International Airport.

At Idlewild, in addition to the regular area weather station, there has been established an Upper Air Center which provides all upper wind, temperature, and turbulence forecasts for the entire AA system. This group, consisting of 9 professional meteorologists and 5 assistants, has become so proficient in handling wind and temperature data that it is unusual for a jet to miss its estimated time of arrival, due to weather conditions, by more than five minutes after a 2500 mile transcontinental flight. And by selecting the best route, wind and weatherwise, passengers are assured a smoother ride while the Company saves time and fuel in its operation.

And while the Upper Air Center is working on the winds and temperatures, the area

Superintendent Peter E. Kraght of American Airlines Upper Air Center employs his Bendix Computer to prepare route forecast.

weather stations are busy forecasting terminal conditions, route weather, thunderstorm activity and the like. Although the jets can fly in all kinds of weather, they are nevertheless particularly sensitive to its variations, more so than piston aircraft. As a consequence, the area forecaster is concerned with accurately forecasting ceiling, visibility, weather, surface winds and temperatures at departure airport for departure time, and at arrival and alternate airports for arrival time. Surface wind and temperature are important factors in determining takeoff capabilities of a jet. The wind direction and velocity is an important factor in determining which runway will be used. This in turn, due to its length, will have a bearing on the amount of payload or fuel that can be carried.

American's Met. department provides a complete weather service to the dispatch organization and over 1600 pilots who operate the Flagship fleet of almost 200 airplanes. This fleet is still expanding with the addition of the latest type Boeing and Convair jets. In order to provide this service, the company maintains 16 drops on the National Weather Facsimile Network to obtain weather map and chart service at key flight planning stations. In addition, there are 73 drops on FAA Service "A" circuits and numerous drops on Service "C", "O" and special weather circuits. The Weather Bureau maintains a drop on the Company's internal teletype network for the purpose of rapidly obtaining pilot weather reports from American's flights anywhere in the United States. A private line telephone network enables company meteorologists to conduct weather conferences several times daily to coordinate forecasts and other weather activities.

ARTHUR F. MEREWETHER
Manager—Weather Service
American Airlines
La Guardia Airport, N. Y.

Meteorological Education in the New York Area

Meteorology and Oceanography at New York University

The Department of Meteorology and Oceanography at New York University offers undergraduate programs leading to the degree of Bachelor of Science in meteorology in both the College of Engineering and the University College of Arts and Science. Graduate programs leading to the degrees of Master of Science and Doctor of Philosophy in either meteorology or physical oceanography are given in the Graduate Division of the College of Engineering and in the Graduate School of Arts and Science. The complete curriculum includes 12 undergraduate courses and 30 graduate courses.

The Department is located in the Bliss Building on the 47-acre University Heights campus in the Bronx. Research activities are housed in two smaller buildings on the campus, West Hall and the Geophysics Building. A 65-foot schooner, the *Action,* is operated by the department as an oceanographic research vessel and classroom. Opportunity for field work in oceanography is offered on the *Action* and also in cooperation with the Woods Hole Oceanographic Institution at Woods Hole, Massachusetts.

Research meteorologists perform an experiment on light scattering in the graduate course in atmospheric physics at New York University. NYU photo by William Simmons.

The department engages in extensive research under contracts with governmental agencies and industry. All the research projects, which are supervised by members of the faculty, employ students as part-time or full-time assistants. In addition to assistantships on sponsored projects, the department offers an unrestricted research assistantship each year to a qualified graduate student. This assistantship provides $3000 with free tuition and fees for one academic year, and the recipient is not assigned any regular duties.

At the present time the department is conducting research on the upper atmosphere, stratospheric meteorology, satellite meteorology, numerical prediction of cyclogenesis, atmospheric turbulence, cloud physics, development of optical radar techniques for measuring ozone and water vapor, local winds, ocean waves, effects of waves on ship motions, and other oceanographic problems. Sponsoring agencies for these projects include the Air Force Geophysics Research Directorate, the Office of Naval Research, the United States Weather Bureau, the U. S. Army Signal Corps, the U. S. Navy Bureau of Ships, and the National Science Foundation.

The staff of the department consists of six faculty members of professorial rank, one visiting professor, four adjunct professors, six instructors, two senior research scientists, and about twenty-five research assistants.

James E. Miller
Chairman, Department of Meteorology and Oceanography
New York University
Bronx 53, New York

Meteorology at The City College

Interest in meteorology at The City College dates back to Cleveland Abbe, class of 1857, who joined the U. S. Signal Corps in 1870 to organize and direct its forecasting service. When this greatly expanded service was later transferred in 1891 to the U. S. Dept. of Agriculture to become the U. S. Weather Bureau, he went as senior professor of meteorology. Abbe was often and justly called the "Father of the Weather Bureau." A planned program of undergraduate specialization in meteorology was not instituted, however, until 1948 with the impetus provided by World War II. Since this time the curriculum has grown steadily and at present includes thirty points of meteorology course work. In addition three graduate courses are offered in the School of Education for teachers of earth science. Forty students are currently matriculated for the Bachelor of Science degree in meteorology, while approximately one hundred and fifty additional students complete at least one meteorology course each year. Pending New York State legislation would give university status to the municipal colleges where master's and doctor's degrees would be offered. It is anticipated therefore that advanced degrees in meteorology will be available in the future.

The meteorology laboratory at The City College is supplied with teletype and facsimile data from the national weather network. The college is a 'Cooperative Observing Station' of the U. S. Weather Bureau, and forwards each day observations for publication. In addition to the usual weather instruments, the station has recently acquired a Gurley wind recorder of new design and has probably one of the best wind instrument exposures in the New York City area (see photo). The college also maintains a modern seismograph installation and as a 'Cooperative Observing Station' of the U. S. Coast and Geodetic Survey provides current data for both earthquake and hurricane occurrences.

At the present time, the meteorology course work is offered by the Geology and Physics departments. Three courses, stressing dynamics are given by the physics staff: Professors John Shea and Harold Stolov. Seven courses stressing forecasting and practical aspects are taught by the Geology Lecturers Richard J. Rommer and Charles Thor, who also offer the graduate education courses. Teaching Fellow Espriela Sarreals assists in the laboratory and Chief Observer Albert Hinn is student assistant. Professor Daniel T. O'Connell, under whose leadership the meteorology program was begun, is director of the Seismograph and Weather Station.

Observer Albert Hinn of City College of New York demonstrates use of instruments to student meteorologist Frances Hennessey. CCNY photo by Conrad Waldinger.

A student chapter of the American Meteorological Society was organized at the College in 1948. It is recognized that New York City with its great number of weather installations offers exceptional opportunties for club activities, such as field trips and guest speakers. The society has enjoyed exceptional success since its inception as evidenced by well-attended, stimulating meetings.

The City College provides a tuition-free college education to qualified New York City residents. New York State residents pay fees except in teacher training. Persons residing outside New York State are not eligible for undergraduate programs except as fee-paying, non-matriculated Evening Division students. Graduate students pay nominal tuition fees. Inquiries may be addressed to the Registrar, The City College of New York, 139th Street and Convent Avenue, New York 31, New York.

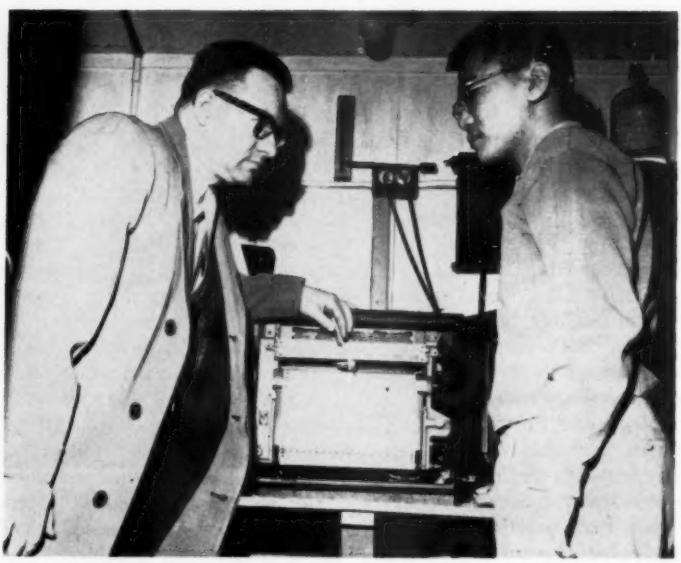
RICHARD J. ROMMER AND CHARLES THOR
Lecturers, The City College of New York
New York 31, New York

Meteorology at Rutgers University

The Department of Meteorology at Rutgers University at suburban New Brunswick, New Jersey, is part of the College of Agriculture and the New Jersey Agricultural Experiment Station. Our chairman, Dr. Erwin R. Biel, came to Rutgers from Austria in 1938 with a broad background of European climatological and meteorological experience. With the establishment of a graduate program in 1946, the Department was set up as a separate unit. At the present time the staff consists of three full time and one half time positions.

Undergraduate courses in elementary meteorology, elementary climatology, and the climates of the United States offer a total of nine credits on the undergraduate level. Approximately 150 students enroll in these courses each year. Most of these students are majors in agriculture, engineering, and the biological or physical sciences, and elect meteorology or climatology to complement their training in their field of specialization. Since only very limited facilities for, and training in weather analysis and forecasting are available, no undergraduate degree program in meteorology is offered. Nevertheless, undergraduates who major in science or engineering and elect the meteorology courses available are provided with an excellent background for specialization in meteorology at the graduate level.

At the graduate level, a program leading to the master of science degree with emphasis on all phases of climatology including micrometeorology is offered. Holders of the bachelors degree in meteorology or in closely related fields who have a desire to specialize in climatology are encouraged to apply for this program. In addition, graduate students who



Prof. Vaughn Havens and Clarence Sakamoto, research assistant, discuss air and soil temperatures at several levels as recorded on a 16-point potentiometer. Rutger University photo.

are specializing in fields which are related to meteorology, such as ecology or soils, frequently minor in climatology resulting in significant contributions to the inter-disciplinary aspects of meteorology and climatology. All of the graduates of the Department are employed at universities or in the U. S. Weather Bureau.

The Department is engaged in various research activities in cooperation with the U. S. Department of Agriculture, the U. S. Weather Bureau, and the Agricultural Experiment Stations of the other Northeastern States. In this connection, a major portion of the climatological records of New Jersey have been placed on punched-cards and have been summarized and analyzed statistically for application to certain special problems in agriculture and related fields, such as low temperature and rainfall probabilities.

The Department also operates an agricultural weather station which is shown in the accompanying photograph. Data of special importance to various agricultural problems are recorded here.

A. Vaughn Havens
Professor of Meteorology
Rutgers University
New Brunswick, New Jersey

Meteorology at Columbia University

On 150 acres of scenic woodland, high on the Palisades overlooking the Hudson River, lies a research facility of Columbia University which is a center of activity in every branch of geophysics. The Lamont Geological Observatory, under the leadership of Vetlesen Prize winner, Professor Maurice Ewing, has, in the course of eleven years, provided a fertile and stimulating climate for inquiring minds interested in all phases of the earth sciences.

The Lamont staff consists of university faculty, staff scientists, graduate students, and supporting personnel. Its research activities are integrated with the graduate programs conducted on the main campus of the University in New York City. Recently, Columbia has expanded its activities in geophysics to include full-scale research and graduate training in meteorology.

The new graduate program leading to the M.A. and Ph.D. degrees is designed to produce top-level research meteorologists with broad backgrounds in the physical sciences and mathematics. The course includes studies in general meteorology, general oceanography, climatology, dynamical meteorology,

Dr. Pfeffer sets up a meteorological exhibit in Schermerhorn Hall on the main campus of Columbia University.

dynamical oceanography, the general circulation of the atmosphere, weather prediction, physical meteorology, elasticity and hydrodynamics as well as courses in geophysics, mathematics, physics and other related sciences.

Meteorological research projects at Lamont cover a broad spectrum of topics including the propagation of waves of all scales in the atmosphere, the development of weather systems, the maintenance of the general circulation of the atmosphere, climatic change, and the interaction between air and sea. The Observatory provides an excellent environment for the cross-fertilization of ideas among meteorologists, oceanographers, seismologists, marine biologists, etc. Opportunities for financial support for the graduate student include research assistantships, fellowships and scholarships.

There is an excellent machine shop at Lamont as well as a 500-foot instrumented tower nearby that is used for micrometeorological studies. In addition, there are exceptionally fine laboratories in the physics and engineering departments in which elaborate equipment is available to students interested in instrumentation and experimental techniques. Students also have access to the various high-speed computing devices that are to be found at Columbia's Watson Laboratory.

Since its inception in 1949, the Lamont Observatory has maintained an extensive program in oceanography with considerable field work being conducted aboard Columbia's *Vema*, a 202-foot, three-masted, auxiliary schooner, and other smaller vessels. A large volume of meteorological and oceanographic data, arising from the Lamont contribution to the International Geophysical Year, is available to students interested in the various analysis programs that are now underway or just getting started. Recently, oceanographic research has been further expanded at Lamont and formal course work in this field has been inaugurated. This should prove to be of great value to students and research scientists in meteorology.

DRS. W. L. DONN AND R. L. PFEFFER
Lamont Geological Observatory
Columbia University
Palisades, New York

Weather in New York's Public Schools

The understanding of weather phenomena is now one of the important functions of the study of science in our elementary schools. This signifies that all children receive the opportunity to detect, interpret and appreciate the factors which together constitute the subject of weather. The study of weather starts in the kindergarten with simple concepts and proceeds sequentially through the grades with the consideration of more complex concepts. Great stress is placed on pupil activity, concept formation and first-hand experiences.

Starting in the kindergarten, children learn that it is warmer in the sun than in the shade, that changes in temperature can be detected by thermometers, that air is a substance that has weight, that winds are caused by air in motion, that clouds are conglomerations of droplets of water or crystals of ice in the sky, and that weather changes occur relatively close to ground levels. Children read thermometers, test differences in temperature, weigh plastic bags of air, measure the velocity of wind, change snow to water and water to ice, and measure the amount of rainfall, just to mention a few of the numerous activities in which they engage.

As the child proceeds through the grades, he learns how to read, interpret and use Fahrenheit thermometers, anemometers, barometers, hygrometers and rain gauges. He is given the opportunity to construct simple weather instruments and keep and interpret charts of daily changes in temperature, pressure, wind velocity and precipitation. "Let's find out," is the order of the day. Our school science fairs abound with projects involving the detection and testing of many of the factors that constitute the subject of weather.

During the last year in the elementary school, students study the functions and operations of the weather bureaus situated all over the United States and in Canada, Mexico and Cuba. They also learn about the cooperation of ships at sea. Groups of students regularly visit the weather bureau in New York City where they are able to observe the work of the meteorologists. Weather maps are studied intensively to enable students to

(*Continued on page 71*)

New York Weather Highlights

David M. Ludlum

CROSSING THE HUDSON ON FOOT

MUCH was made in the old-fashioned days about walking over the Hudson River ice from New York to New Jersey. Many attempted to accomplish this feat, often at the risk of their lives, to be able to tell their grandchildren of their fool-hardiness.

We have at hand reliable information about ice conditions since the close of the Seventeenth Century. It appears that the Hudson River between Manhattan and Jersey City or Hoboken was navigable on foot in the following winters: 1696–97, 1705–06, 1719–20, 1740–41, 1751–52, 1760–61, 1764–65, 1779–80, 1783–84, 1804–05, 1820–21, 1835–36, 1856–57 (limited), and 1874–75.

The last mass crossing "by thousands" took place in early February 1836 when refreshment stands were set up in mid-ice. In January 1857 only a few dared the venture, and in February 1875 on the 10th "fully 200 persons crossed" in the early morning, but by 1100 four tugs attacked the central floes and with the help of the ebb tide cleared a channel.

The East River presented an entirely different situation. The tide there ebbs about two hours later than in the Hudson, and this factor tended to sweep loose ice cakes from the Hudson around the Battery into the East River where jamming near the site of the present Brooklyn Bridge formed temporary ice bridges. This rendered the river crossable on foot in approximately twice the number of years as was the Hudson. The last authentic mass crossing of the East River occurred on 13 March 1888, the second day of the Great Blizzard, "by thousands for a few hours" until the ebbing tide broke up the blockade.

It has not been climate change, of course, that has eliminated the ice bridges in the rivers, but the advent of steam and electric power to provide the necessary force to move or break ice floes. It would be interesting, though, to see what a repetition of the continued great freeze of January 1780 would do to the modern harbor facilities.

A WINTER TRAGEDY

December of 1705 brought some of the coldest weather that had ever been experienced by the colonists in America. The Hudson River froze over and remained fast for several days at Christmas time, the earliest such freeze on record. Just before this, on the 19th, what was described as a private ship of war or privateer under the command of one of Capt. Kidd's men, set sail from Manhattan with a crew of 145 men of Dutch and English descent, most of them born in America.

A bitter northwest gale sprang up and impelled the ship down the Lower Bay at such a clip that it struck fast on the bank of Sandy Hook. The only small boat aboard was lowered and nine of the crew set off to find assistance. The gale with near-zero blasts continued all night and the next day. Small boats were prevented from going to the rescue by the height of the wind and waves, but sailors could be seen moving about on the now half-submerged ship.

When boarding parties reached the stricken vessel the following day, they found only four men alive—the remainder had frozen to death in the heatless hulk. Thus, only 13 survived of the entire crew of 145 who had set sail for the tropics in that December gale.

THE HARD WINTER OF 1780

Though the name of Valley Forge is synonymous with winter suffering, the second winter at Morristown in 1779–80 proved far more rigorous for General Washington's troops. For many years afterward this was known as "The Hard Winter" for its combination of heavy snows followed by a month's deep freeze.

The first phase of the season commenced on 18 December when "a terrible snow storm. Half a leg deep and more" laid down a blan-

ket of white that was to remain for eight weeks. At the turn of the year three successive snowstorms struck, with the final one on 5–6 January being a severe blizzard. At New Haven a total of 52″ fell in this period, and snow cover in New Jersey was thought to be 36″ deep.

The second phase commenced on 11 January with the arrival of an arctic air mass that took up residence over the Northeast for a full month. The Philadelphia temperature record shows only one day in January, the 30th, with a maximum above freezing; the mercury in New York City reached its nadir on 29 January, we are told by diarist Lt. MacKenzie of the Royal Engineers, when a low mark of − 16° was registered.

The intense cold of early January soon created ice bridges across the complex of waterways making up New York harbor, a fact which greatly complicated the British problem of defense. On 15 January the East River to Long Island was crossed on foot, and by the 24th the Hudson River to New Jersey was navigable for pedestrians. By the 29th Staten Islanders were able to cross the the five-mile stretch of the Upper Bay to Manhattan, on the 1st of February a 4-horse sleigh was driven across, and on the 6th as many as 86 sleighs went to Staten Island with provisions for the British troops there. It was said that the ice withstood the transport of the heaviest cannon.

The first overnight thaw since mid-December set in on 14–15 February. A channel in the ice through the Upper Bay was soon cut to free some ice-bound vessels, and by the 24th navigation became completely open in the Bay—after a full month of an ice-locked harbor.

A SUMMER TRAGEDY

The mercury had climbed into the low nineties and hardly a breath of air moved on Sunday afternoon of 1 July 1792. Many persons sought relief from the heat spell on the inviting waters that surround Manhattan Island, enjoying a pleasant sail in the harbor or swimming at one of the many beaches. "About 4 o'clock a most violent hurricane came from the westward," the *Daily Advertiser* reported, "its appearance was very alarming, and for the short time it continued, effected considerable mischief. Many houses were injured by the falling down of chimnies, and tareing away of pantiles, &c."

Out on the rivers and bays many canoes and boats were capsized by the sudden storm, resulting in the loss of at least 29 young men and women. The tragic story was given wide publicity in the press and received historic substance by the issue of a theological-meteorological pamphlet: *A True and Particular Narrative of the Late Tremendous Tornado, or Hurricane, at Philadelphia and New York.* The purpose of the publication was to admonish all potential Sabbath-breakers of the horrible fate that the Almighty might have in store for them.

The storm appears to have been a very intense line squall such as occur at this time of year. The press reported "the whole country from Philadelphia to New York is said to be marked with its ravages." New York's weatherman of the period, Henry Laight, did not take observations on Sundays, but down at Quaker Philadelphia we learn that at 1400 the temperature stood at 93.9°, the wind out of the west-southwest, and the sky "overcast with storm." No doubt, these conditions were much the same at New York City when the fateful blow struck.

THE LONG ISLAND HURRICANE OF 1821

Available records indicate that only one *major* hurricane in the past two hundred years has passed directly over a part of present-day New York City. After striking a devastating blow at eastern North Carolina and the Norfolk area in Virginia, a severe hurricane swept up the New Jersey coast during the afternoon of 3 September 1821. Close to 1800 the center smashed ashore near present New York International Airport (Idlewild). After speeding through eastern Queens and western Nassau counties, the whirl crossed Long Island Sound about on the Oyster Bay-to-Stamford axis, and then raced north-northeastward astride the hill country on the New York–Connecticut border.

The New York Post described the scene: "the wind veered and shifted to almost every point of the compass, when about half past four o'clock it came out from almost east, with all the violence and fury of a hurricane, and continued to half past 8, throwing down

chimnies, unroofing buildings, and prostrating trees in various directions. When the gale was at its height, it presented a most awful spectacle. The falling slate from the roofs of buildings, and broken glass from windows, made it unsafe, for anyone to venture into the streets."

The gale on Manhattan Island, according to local meteorological records, first came in gusts from the southeast, about 1600 shifted to northeast, and by 1900 backed around to west-northwest. A low barometer of 29.38″ was reported at 1930. The wind force mounted high enough to do major structural damage. All but two or three of the wharves on the North and East Rivers suffered damage, and the sea wall at the Battery when breached by the storm-tide lost its earthen fill as far back as the first row of trees.

To the eastward the gale proved one of "the most awful and desolating ever experienced," according to the *Long Island Star*. Many marine disasters "of a most meloncholy nature" occurred along the South Shore of Long Island and the Connecticut shore of the Sound. Barns were flattened in the Huntington area, and whole houses blown down at Greenwich.

MAY SNOWSTORMS

Only two cases appear in the records of May snowstorms with sufficient accumulation to lay on the ground for an appreciable time. On 4 May 1774 a mantle of white spread over the Middle Atlantic Coast states from Virginia to Connecticut. A heavy rain on the evening of the 3rd turned to snow toward morning and continued into the forenoon. At New York "a considerable quantity" fell, according to Prof. W. L. Mitchell of Columbia, and at Elizabeth, New Jersey, the ground was white. In the northern suburbs of Philadelphia the accumulation amounted to 4″.

On the morning of 8 May 1803 "a considerable fall of snow for several hours" occurred. Henry Laight's thermometer read 34° at 0800. The snow continued until 1100, and the rest of the day "was cold and disagreeable." Gerard Rutgers, across the Hudson River at Belleville, "cut a mess of asparagus, the beds covered with snow" that morning.

Other May days had either snowshowers or snow mixed with rain. On 4 May 1812 "violent snow 10 to 3 o'clock" was reported with the mercury at 36°. Heavy accumulations were received inland. On 25 May 1845 some flakes were observed on 14th Street, and the Harlem and Bronx area had brief white accumulations. Then on 3–4 May 1861 mixed rain and snow fell at intervals, though without accumulation.

Modern records taken by the Weather Bureau show no measurable May snowfalls. At the Battery a trace of snow was mixed with rain on 6 May 1891 and a trace of sleet fell on 4 May 1946. The Central Park records show only one such instance—a trace, probably sleet, was observed on the 1946 date.

OCTOBER SNOWS

The outstanding October snow occurred on 26–27 October 1859 when morning risers were greeted with "about four inches in depth" on Manhattan Island. Over in Newark the fall was measured at three inches, with the snow period commencing at 2000/26th and ending at 0800/27th. The mercury stood at 29° at the conclusion of the snow.

Weather historians then recalled that the last previous October snow had fallen in October 1810 when a unique snow situation commenced. The trace that fell on the 31st was just a preliminary to the greatest early season snow in all New York records; for on 1–2 November 1810 "a very deep snow and heavy gale" occurred. Snow commenced in the late evening of the 1st and continued until late afternoon of the 2nd. The mercury stood at 28° on the morning of the 2nd. With the snow depth reaching 7″ and the mercury remaining below freezing all day, sleighs appeared on the New York streets.

Snowfall at the conclusion of a late-season hurricane is not unusual at hill country places inland. The earliest such occurrence at New York appears to have been on the night of 3–4 October 1841 when William C. Redfield noticed snow mixed with the rain that night. Snow also fell at New Brunswick, N. J., and in Connecticut accumulated to some depth: New Haven 3″, and Middletown highlands 12″.

In modern records no October snowfall has brought as much as 1″ to the city although on three occasions lesser quantities have been measured. On 15 October 1876, 0.5″ of sleet accumulated at the end of a rainstorm; on 30

October 1925 the center city fall was 0.8″ with more in the suburbs; and on 29 October 1952, 0.5″ whitened the ground at Central Park.

An early colonial report, which has been confirmed from several sources, shows that a general snow fell from Philadelphia northeastward to New Hampshire on 9–10 October 1703 (New Style) with measurable accumulations. At Philadelphia the snow lay for 24 hours without completely melting.

THE COLD FIRE OF 1835

The greatest fire in New York City's history occurred on the night of 16 December 1835 when a conflagration consumed 21 blocks in the heart of the then commercial district on the lower East Side. The fire raged for three days, 648 buildings and houses were consumed at an estimated loss of $18 million. Philip Hone, the eminent diarist of New York life, described the night "as intensely cold, which was one cause of the unprecedented progress of the flames, for the water froze in the Hydrants, and the engines and their hose could not be worked without great difficulty."

It so happened that 16 December 1835 was the bitterest daylight period ever experienced in upper New York State and New England, even outdoing the celebrated Cold Friday of 19 January 1810 for degree of frigidity. At sunrise of the 16th the mercury froze at Gouverneur and Lowville in northwestern New York with readings on the standard Academy thermometers below − 40° F., and during the day a bitter northwest gale carried the core of the cold air southeastward across New York and all New England. Norfolk, only 80 miles north-northeast of New York City, endured these frigid readings on the 16th: 0900, − 15°; 1500, − 14°; 1900, − 18°.

New York City, itself, was just to the south of the stream of coldest air. Many thermometers in the city touched zero on the night of the 16–17th, when the fire was at its height and the core of coldest air closest to the city. By morning Erasmus Hall in Brooklyn read + 4° and Union Hall in Jamaica had + 3°. Out on Long Island at East Hampton, in the cold air advection, the low reading on the morning of the 17th was − 2°.

THE COLD STORM OF 1857

The thermometer at Erasmus Hall read just 0.1 degree above zero at 1400 on Sunday afternoon, the 18th of January in 1857. Snow commenced falling within the hour as a major storm swept up the coast from the Carolinas. In Virginia it was the severest snowstorm of the Nineteenth Century; in the New York–New Jersey area it was the coldest major snowstorm in recorded weather history; and in southeastern New England it proved the deepest snowfall since 1831 and was not to be equaled until 1960. The storm possessed all the elements of a true Eastern blizzard: heavy snow, temperatures below 10° during the snow period, and strong northeasterly gales of sufficient force to topple church steeples.

One New York observer clocked the snow as commencing at 1430/18th and stopping at 1700/19th. Depths were hard to measure due to the gale force winds—most observers reported 12″ although the figure at Erasmus Hall was 8″. The mercury crept up from zero slowly after the onset of the snow, reaching 5° at 2100 in Flatbush. Next morning the thermometer had sunk back to 2.7°, all the while a northeast gale raging with blinding snow. The wind shifted to northwest at 1100/19th and the snow eased off somewhat.

Railroad traffic in and out of New York came to a halt. Bergen Cut through the Palisades was filled with a snowbank 12 feet deep. After being snowbound all Monday, three locomotives attacked the blockade and finally reached Newark at 1400/20th—just 24 hours after the heavy snow had ceased. *The New York Times* in an editorial added an ageless, acid comment: "The recent fall of snow has not seriously interrupted the Long Island Railroad travel, the first snow storm of the season having done that job. Trains will recommence running it is fervently hoped in the Spring."

A ZERO DAYLIGHT

Records for daily temperature readings in New York City are available from 1788 to the present. Though little is known of the exposure of some of the early instruments and maximum-minimum thermometers were not always employed, one can with confidence state that on only one day from 1788 to 1961

has the mercury failed to rise above the magic zero mark in daylight. It required a particular timing of the arrival and departure of an intense arctic outbreak to accomplish this unique feat.

At 2100 on 9 January 1859, the mercury at Erasmus Hall in Flatbush stood at + 10°. Next morning at 0700 it was down to − 3.7° and it continued to slump all morning, despite a clear sky, to − 7.5° at 1100. At Brooklyn Heights the morning low was − 9° and in upper Manhattan − 10°. There was a slight recovery in early afternoon at Flatbush to − 3.8°, but thereafter another descent dropped the mercury back to − 8° at 2100.

The lowest point of all was reached near midnight with readings of − 10° and − 12° in Manhattan and − 12.5° at Newark. A gradual rise then followed to − 6° at 0700 on the 11th and to zero by noon. Thus, the mercury stood below zero for approximately 30 hours. Since we do not know the exact hour it first went below zero on the night of the 9–10th, we cannot state that the 10th was a zero day according to Weather Bureau terminology with both max. and min. below zero.

The closest approach to a zero daylight since then came on 9 February 1875: + 1 at 0700, 0 at 1400, and + 2 at 2100. The zero in early afternoon of the 9th was the minimum for the month of February, the third coldest 2nd month in New York's ninety-year span of Weather Bureau records.

THE SNOWIEST WINTER

Snowfall records for points in the New York Metropolitan area are available from 1843 to the present. A careful examination of this mass of monthly and seasonal totals indicates that the season of 1867–68 was the snowiest in New York's recorded history. The Newark records, which were carefully kept from 1843 until 1892, showed a total snowfall in that season of 75.25″, made up of monthly totals as follows: Dec. 15.5″, Jan. 23.75″, Feb. 14″, March 15″, and April 7″. The largest individual storms during the season 1867–68 were: 10.5″ on Dec. 12, 10″ on Jan. 29, and 9″ on March 2. It was primarily the persistency of cold weather all winter that produced many small snowstorms to swell the total to record amounts. The four winter months of this snowiest season, from December through March, proved the coldest such four-month span in the entire New Haven record from 1780 to 1960.

Records had fortunately been commenced at Central Park at the beginning of 1867 and these again promote 1867–68 as the snowiest winter in the span from 1867 to 1961. The Central Park figures, as taken from the annual report of the Park Commissioners and the press, show the following monthly totals: Dec. 17.2″, Jan. 23.7″, Feb. 16.5″, Mar. 22.75″, and April 7.5″—for a seasonal total of 87.25″. The private records of Jonathan Marie indicate a seasonal amount of 88.75″. These figures are generally backed up by others taken by meteorologists of the *New York Tribune*, Erasmus Hall, Columbia University, and the Deaf & Dumb Institute. At Trenton, New Jersey, and Wallingford, Connecticut, the season of 1867–68 was also the snowiest in their long span of records.

The current official records for New York City, which commenced with the formal establishment of the New York Meteorological Observatory at Central Park in 1869, indicate that there have been only three years in which more than 60″ has fallen: 1947–48 (63.2″), 1922–23 (60.4″), and 1872–73 (60.3″).

THE TORNADO OF 1895

An authentic tornado with funnel cloud observed crossed the northern and eastern part of the city on mid-afternoon of 13 July 1895. Whether there were three funnels or just one with a skipping motion was not determined, but the three locations where damage was reported were in a line from northwest to southeast.

Cherry Hill in Bergen County, New Jersey, about 1.5 miles north of Hackensack, felt its effects at 1550. Considerable damage was done to dwellings to the extent of $50,000. The next destruction came in the Harlem area of upper Manhattan Island, though the losses there were minor. The final touching point of the skipping storm came in Woodhaven in southwestern Queens where one person was killed and damage of $45,000 caused. The whirl then moved out into Jamaica Bay, close to Idlewild Airport, where the waters were seen to be considerably disturbed.

(*Continued on page 78*)

A Concise Climatology of the New York Metropolitan Area

LOWER MANHATTAN

Month	Temperature: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal degree days	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs	Year	Snow, Sleet: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: 7:00 A.M., EST	8:00 P.M., EST	7:00 P.M., EST	Wind: Mean hourly speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct of poss sunshine	Average sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Sleet, .10 or more	Thunderstorms	Heavy fog	Max. temp.: 90° ∧ ≥	32° ∨ ≥	Min. temp.: 32° ∨ ≤	0° ∨ ≤
(a)	(b)	(b)	(b)	90		90		(b)	(b)	90		90		90		76	76		76		72	43	72	49	††	49			67	70	90	90	90	90	76	77	56	89	89	89	89
J	39.9	25.8	32.9	71	1950	- 6	1875	995	3.46	6.82	1936	0.81	1955	3.42	1944	7.3	26.2	1925	13.4	1935	72	62	66	16.4	NW	76	SW	1913	51	6.2	8	10	13	12	2	•	3	0	8	23	•
F	40.1	25.3	32.7	73	1930	-14	1934	904	3.13	7.81	1893	0.82	1895	3.25	1886	8.9	37.9	1894	17.6	1893	70	59	63	16.8	NW	91	SW	1912	57	5.8	8	9	11	10	2	•	2	0	6	22	•
M	48.5	32.8	40.7	84	1945	3	1872	753	3.56	7.91	1953	0.86	1910	3.60	1876	5.8	28.5	1896	16.5	1888	69	56	62	17.0	NW	91	SW	1913	59	5.9	9	11	12	12	2	1	2	0	2	16	0
A	57.9	41.7	49.8	91	1915	12	1923	456	3.22	7.02	1874	1.00	1881	3.72	1886	1.0	10.2	1915	10.2	1915	69	54	62	15.6	NW	95	NW	1912	60	5.3	8	11	11	11	•	2	2	•	•	4	0
M	69.0	52.5	60.8	95	1895	34	1947	153	3.51	9.10	1908	0.33	1903	4.17	1908	T	T	1891	T	1891	71	56	64	13.4	NW	74	W	1945	61	5.6	8	12	11	11	•	4	2	•	0	0	0
J	77.7	61.8	69.8	97	1899	44	1929	18	3.70	7.86	1922	0.16	1949	3.88	1917	0	0	----	0	---	74	58	66	12.7	S	94	W	1952	64	5.7	8	13	9	10	0	5	1	1	0	0	0
J	82.3	66.9	74.6	102	1936	54	1914	0	4.34	9.97	1960	0.23	1910	4.90	1960	0	0	----	0	---	76	58	67	12.0	S	95	NW	1914	65	5.7	8	13	10	11	0	7	1	3	0	0	0
A	80.4	66.0	73.2	102	1918	51	1885	0	4.34	13.82	1955	0.58	1916	6.71	1955	0	0	----	0	---	78	60	69	11.6	S	74	NW	1944	63	5.6	9	12	10	10	0	6	•	2	0	0	0
S	74.5	60.1	67.3	100	1881	38	1912	39	3.67	14.51	1882	0.11	1941	6.17	1882	0	0	----	0	---	78	60	68	12.3	N	99	N	1944	64	5.2	11	10	9	9	0	3	1	1	0	0	0
O	64.5	49.5	57.0	90	1941	27	1936	263	3.04	11.55	1903	0.30	1924	9.40	1903	T	0.4	1925	0.4	1925	75	59	66	13.8	NW	113	SE	1954	63	5.0	11	10	10	9	0	1	2	•	0	•	0
N	53.0	39.5	46.3	81	1950	7	1875	561	3.09	9.92	1889	0.61	1931	3.62	1892	0.9	14.0	1898	8.8	1898	73	61	65	15.7	NW	87	W	1934	56	5.5	9	9	11	9	•	•	2	0	•	6	0
D	42.4	28.9	35.7	69	1946	-13	1917	908	3.07	7.03	1936	0.21	1955	3.23	1941	6.2	29.0	1947	25.8	1947	74	62	65	16.1	NW	91	NW	1934	53	6.0	8	10	12	10	2	•	2	0	5	20	•
Yr	60.9	45.9	53.4	102	July 1936	-14	Feb 1934	5050	42.03	14.51	Sept 1882	0.11	Sept 1941	9.40	Oct 1903	30.1	37.9	Feb 1894	25.8	Dec 1947	73	59	65	14.5	NW	113	SE	1954	60	5.7	104	131	130	124	8	30	20	7	22	91	•

(a) Length of record, years. (b) Normal values are based on the period 1921–1950.

†† 40-year normal.

CENTRAL PARK

Month	Temperature: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal degree days	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Sleet: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: 7:30 A.M., EST	1:30 P.M., EST	7:30 P.M., EST	Wind: Mean hourly speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct of poss sunshine	Average sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Sleet, .10 or more	Thunderstorms	Heavy fog	Max. temp.: 90° ∧ ≥	32° ∨ ≥	Min. temp.: 32° ∨ ≤	0° ∨ ≤
(a)	(b)	(b)	(b)	92		92		(b)	(b)	92		49		92		92	92		92		41	41	41	41	41				84	36	36	36	36	92	90			47	47	47	47
J	39.2	26.1	32.7	72	1950	-6	1882	1001	3.57	7.94	1915	.77	1955	3.33	1915	7.6	27.4	1925	13.0	1935	68	61	61	11.1	NW				49	6.2	8	9	14	11	2			0	8	22	•
F	39.4	25.5	32.5	75	1930	-15	1934	910	3.26	6.87	1869	.46	1895	2.98	1941	8.5	27.9	1934	12.5	1921	68	59	60	11.1	NW				56	5.9	8	9	11	10	2			0	6	20	•
M	48.5	33.2	40.8	86	1945	3	1872	747	3.67	8.79	1876	.90	1865	4.25	1876	5.5	30.5	1896	18.1	1941	68	56	59	11.3	NW				57	5.8	8	10	13	12	2			0	2	14	0
A	58.8	42.1	50.5	92	1915	12	1923	435	3.35	8.77	1874	.95	1881	2.67	1886	1.1	13.5	1875	10.2	1915	68	54	58	10.8	NW				59	6.0	7	11	12	11	•			•	0	2	0
M	70.9	52.8	61.9	96	1941	32	1891	130	3.76	8.51	1908	.30	1903	3.82	1908	0	T	1946	T	1946	72	54	61	9.0	SW				62	5.8	7	13	11	11	0			1	0	0	0
J	80.0	62.2	71.1	101	1934	44	1945	7	3.67	9.78	1903	.02	1948	4.74	1884	0	0		0		74	56	62	8.4	SW				65	5.7	7	13	10	10	0			3	0	0	0
J	84.7	67.4	76.1	106	1936	52	1943	0	4.22	11.99	1889	.49	1910	3.56	1960	0	0		0		76	57	64	7.9	SW				66	5.6	8	13	10	11	0			6	0	0	0
A	82.6	66.0	74.3	104	1918	50	1885	0	4.40	10.86	1955	.54	1916	4.80	1909	0	0		0		78	58	67	7.8	SW				64	5.6	9	12	10	10	0			4	0	0	0
S	76.6	59.9	68.3	102	1953	39	1912	31	4.02	16.85	1882	.21	1884	8.30	1882	0	0		0		79	59	67	8.3	SW				64	5.2	10	11	9	8	0			1	0	0	0
O	65.6	49.5	57.6	94	1941	28	1936	250	3.03	13.31	1903	.28	1924	11.17	1903	T	0.8	1925	0.8	1925	76	56	63	9.3	SW				61	5.1	11	10	10	8	0			•	0	•	0
N	53.1	40.0	46.6	84	1950	5	1875	552	3.23	9.97	1889	.60	1931	3.65	1889	1.1	19.0	1898	10.0	1898	73	60	63	10.3	NW				53	5.9	9	9	12	9	•			0	•	5	0
D	42.1	29.6	35.9	70	1946	-13	1917	902	3.18	7.53	1936	.25	1955	3.21	1909	6.2	29.6	1947	26.4	1947	69	61	62	10.6	NW				60	6.0	9	9	13	10	2			0	5	19	0
Yr	61.8	46.2	54.0	106	Jul 1936	-15	Feb 1934	4965	43.36	16.85	Sep 1882	.02	June 1949	11.17	Oct 1903	30.0	30.5	Mar 1896	26.4	Dec 1947	72	58	62	9.7	NW				59	5.7	101	129	135	121	8			15	21	81	•

(a) Length of record, years. (b) Normal values are based on the period 1921–1950

LAGUARDIA AIRPORT, QUEENS CO.

Month	Temperature: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal degree days	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Sleet: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: 7:00 A.M., EST	1:00 P.M., EST	7:00 P.M., EST	1:00 A.M., EST	Wind: Mean hourly speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct of poss sunshine	Average sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Sleet .10 inch or more	Thunderstorms	Heavy fog	Max. temp.: 90° and above	32° and below	Min. temp.: 32° and below	0° and below
(a)	(b)	(b)	(b)	20		20		(b)	(b)	20		20		20		16	16		16		20	20	20	1																			
J	39.1	26.8	33.0	72	1950	0	1957	992	3.19	5.77	1949	0.85	1955	2.12	1944	6.5	18.2	1948	6.8	1954	69	59	63	67																			
F	39.2	26.0	32.6	74	1949	-7	1943	907	3.04	5.76	1960	1.67	1943	2.90	1941	7.8	21.3	1947	11.7	1947	68	54	61	67																			
M	46.2	32.8	40.5	86	1945	7	1943	760	3.50	8.73	1953	1.63	1949	3.25	1953	6.5	18.9	1958	15.3	1960	68	51	61	61																			
A	58.4	41.7	50.1	89	1942	23	1943	447	3.10	7.24	1958	1.21	1942	2.52	1958	1.1	6.4	1956	6.4	1956	69	54	62	71																			
M	70.0	52.5	61.3	96	1952	37	1947	141	3.33	7.42	1948	1.22	1944	2.08	1951	0	0		0		71	50	64	75																			
J	78.6	62.3	71.0	101	1952	45	1945	10	3.38	5.93	1948	0.03	1949	3.26	1946	0	0		0		72	51	64	72																			
J	84.0	67.8	75.9	101	1957	56	1943	0	4.12	9.27	1960	0.69	1954	3.46	1960	0	0		0		74	54	63	71																			
A	81.8	66.9	74.4	103	1948	53	1940	0	4.27	16.05	1955	2.43	1957	7.11	1955	0	0		0		76	55	67	79																			
S	73.6	61.1	68.8	102	1953	42	1947	28	3.55	8.04	1944	0.62	1941	3.70	1960	0	0		0		76	58	70	80																			
O	65.0	50.2	57.6	93	1941	32	1940	250	2.91	9.09	1943	0.86	1952	3.36	1943	T	T	1952, 1960	T	1952, 1960	75	58	69	77																			
N	53.0	40.5	46.8	83	1950	17	1955	546	2.99	7.92	1951	1.03	1949	3.21	1950	0.6	4.0	1953	4.0	1953	71	55	66	76																			
D	41.6	29.7	35.7	70	1946	-2	1942	908	3.00	5.31	1948	0.31	1955	3.44	1941	8.3	26.2	1947	22.8	1947	68	57	64	72																			
Yr	61.3	46.5	53.9	103	Aug. 1948	-7	Feb. 1943	4989	40.38	16.05	Aug. 1955	0.03	June 1949	7.11	Aug. 1955	30.8	26.2	Dec. 1947	22.8	Dec. 1947	71	54	64	70																			

(a) Length of record, years. (b) Normal values are based on the period 1921-1950

NEWARK AIRPORT, NEW JERSEY

Month	Temperature: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal degree days	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Sleet: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: EST 1:00 a.m.,	EST 7:00 a.m.,	EST 1:00 p.m.,	EST 7:00 p.m.,	Wind: Mean hourly speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct. of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Sleet 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures Max.: 90° and above	32° and below	Min.: 32° and below	0° and below
(a)	(b)	(b)	(b)	19		19		(b)	(b)	07		07		07		18	19		19		19	19	19	19	17	19					15	19	19	19	19	19	19	19	19	19	19	19	19
J	39.0	24.0	31.5	74	1950	0	1957+	1039	3.60	5.57	1953	.81	1955	1.39	1959	6.3	16.4	1948	7.3	1943	70	72	56	65	11.2	NE					6.7	7	7	17	12	2	3	0	6	25	•	•
F	39.5	23.9	31.7	76	1949	- 7	1943	962	3.21	4.47	1956	1.89	1959	1.87	1958	6.5	20.5	1947	12.7	1958	69	70	56	59	11.6	NW					6.3	7	8	13	10	2	•	2	0	9	22	•	•
M	49.2	31.8	40.5	89	1945	6	1943	760	3.78	6.29	1954	2.73	1957	1.76	1958	6.0	26.0	1956	17.6	1956	68	66	53	60	12.0	WNW					6.2	8	9	14	12	1	1	2	1	15	0	0
A	59.5	40.4	50.0	91	1960+	23	1954	450	3.27	6.41	1958	2.05	1959	2.01	1958	.8	4.1	1957	4.1	1957	71	70	50	61	11.1	WNW					6.6	7	9	14	12	•	1	2	0	2	0	0
M	71.3	50.9	61.1	94	1949	33	1947	148	3.73	4.11	1960	1.47	1959	1.11	1954	T	T	1956	T	1956	74	72	52	62	9.9	SW					6.6	6	11	14	13	0	4	2	1	0	0	0
J	80.5	60.4	70.5	102	1952+	43	1945	11	3.80	3.68	1958	.85	1954	1.52	1959	.0	.0		.0		78	73	52	63	9.3	SW					6.0	7	12	11	10	0	5	2	1	0	0	0
J	84.9	65.6	75.3	105	1949	52	1945+	0	4.20	6.39	1960	1.14	1955	2.54	1960	.0	.0		.0		79	74	51	64	8.7	SW					6.2	7	12	12	10	0	7	1	1	0	0	0
A	82.6	63.6	73.1	103	1948	51	1942	0	4.19	11.84	1955	2.39	1958	4.17	1959	.0	.0		.0		81	78	53	67	8.4	SW					6.0	8	11	12	9	0	4	1	1	0	0	0
S	76.5	57.1	66.8	105	1953	35	1947	47	3.89	6.23	1960	2.10	1956	4.06	1954	.0	.0		.0		81	81	54	69	8.6	SW					5.6	10	8	12	9	0	2	2	1	0	0	0
O	65.4	45.8	55.6	92	1949	30	1948	301	3.20	6.70	1955	1.75	1954	2.53	1958	T	.3	1952	.3	1952	79	80	53	68	9.3	SW					5.4	11	8	12	8	0	3	•	0	•	0	0
N	53.2	36.6	44.9	85	1950	15	1955	603	3.10	4.79	1954	1.97	1958	1.52	1954	.5	2.9	1945	2.9	1945	74	77	55	66	10.0	SW					6.0	9	8	13	10	•	2	0	•	2	0	0
D	41.4	26.6	34.0	72	1966	- 1	1962	961	3.10	5.74	1957	.27	1955	1.83	1960	8.4	29.1	1947	26.0	1947	71	73	57	65	10.5	SW					6.2	9	8	14	11	2	•	2	0	5	22	•	0
YR	61.9	43.9	52.9	105	SEP 1953+	- 7	FEB 1943	5252	43.07	11.84	AUG 1955	.27	DEC 1955	4.17	AUG 1959	28.5	29.1	DEC 1947	26.0	DEC 1947	75	74	54	64	10.1	SW					6.2	96	111	158	126	7	25	24	25	17	95	•	0

Means and extremes in the above table are from existing or comparable location (s). Annual extremes have been exceeded at prior locations as follows: lowest temperature -14 in February 1934; maximum monthly precipitation 11.48 in August 1843; minimum monthly precipitation 0.07 in June 1949; maximum precipitation in 24 hours 4.59 in September 1944.

THE BLIZZARD OF '88

The Blizzard of '88. Irving Werstein. Thomas Y. Crowell, New York, 1961. 157 pages. $4.50.

It was probably inevitable, in view of the popularity of "the day it happened" genre, that the blizzard of '88 in New York City would be subject to dissection by an avid researcher. Irving Werstein, whose two previous publications dealt with Civil War themes, selected the blizzard for his attention and has produced the "first full-length book on the fabulous storm." The text consists of 157 pages of large type with 36 excellent illustrations scattered throughout, many of them covering half and full pages.

In his preface Mr. Werstein states his purpose with clarity: "I did not tell this story chronologically—the reader will find this to be no minute-by-minute, snowflake-by-snowflake account of the blizzard. I have chosen instead to describe the effect of such a natural catastrophe upon individuals and whole cities, both physically and psychologically. My purpose was to bring alive once more the terror evoked by the storm whether at sea or at land. I have tried to recapture the irony of men and women dying in the streets of densely populated cities."

Within the limits of his stated purpose, the author has woven together an immensely interesting series of blizzard-connected episodes. No aspect of the city's life has been neglected, with the "gay-nineties" arena of the entertainment world receiving full billing.

The book reads well. Though most economical in the expenditure of words and sentences, Mr. Werstein has a smooth-flowing style that is at once clear, packs a punch, and is well suited to the subject. His use of created conversations, all based on actual incidents reported in the contemporary press, adds much flavor, in many cases making the chapters live as if the events had just occurred in the 3–4 February 1961 big snow.

The descriptive scenes that I enjoyed most dealt with the mass crossing of the East River by ice pedestrians on the second day of the storm when a massive floe became lodged from shore to shore near the Brooklyn Bridge. Also the bacchanalian scene at the congested ferry house of the Central R.R. of New Jersey, where cross-river transportation had been stopped by the storm, provides a vivid description of a unique event that should live long in the city's folklore.

But anyone with the slightest intellectual curiosity about the physical nature of the storm will be sorely disappointed in what he finds in this brief book. Either the author or his editors decided that even the mention of a barometric reading would make the work unpalatable to the reading audience, even in this supposedly science-orientated age. The author gives no hint either in his acknowledgments or in the text itself of having sought the assistance of a meteorologist or of having digested any of the published meterological material of the storm. We find the old press "chestnut" about two storms having joined over New Jersey to make one big one. The inclusion among the illustrations of a set of daily weather maps (these are readily available) would have done graphically what thousands of words could not do. Again, in many instances, there appear needless exaggerations in regards to temperature, snow depths, and wind speeds, probably taken from the press, that a check against the recorded facts would have corrected. The author's reluctance to tackle the scientific aspects of the blizzard, to my mind, comprises a major omission and in the long run will seriously detract from the value of the book, from its becoming the final authority on the blizzard for future generations. One needs only to recall the enormous, 20-year success of George Stewart's *Storm*, in which correct meteorology was blended with intense human drama to produce a classic.

Perhaps it might be well here, considering the theme of this issue of *Weatherwise*, to set down for our readers the basic meteorological facts of the Blizzard of '88 in New York City as they appear in the manuscript records of the U. S. Signal Corps weather station in lower Manhattan:

Sunday, 11 March: Rain commenced at 1430 0.65″ measured at midnight. Temperature in mid-30's, read 34.9° at midnight.

Monday, 12 March: Rain changed to snow at ten minutes after midnight—10″ on ground at 0700, 15.5″ by 1500—another 1″ fell before midnight—total day's fall 16.5″. Barometer reached low of 29.21″ at 1000, commenced very slow rise at 1300. Max. temp. 34.9°, min. 10.7°. Wind speed: 48 mph max., 32.8 mph average from northwest, then west.

Tuesday, 13 March: Light snow ended at 0555—began again at 1355, ended at 1905—flurries later—total day's fall 3.0″.

Wednesday, 14 March: Light snow ended at 0340—resumed 0625–0715 and 1040–1450—total day's fall 1.4″. Three-day storm total—20.9″.

TEMPERATURE & WIND DATA

	0700	*1500*	*2200*
12 March	24°	17°	11°
	NW 37	NW 35	W 34
13 March	6°	12°	14°
	W 37	W 39	W —
14 March	23°	39°	34°
	NW 14	N 13	NW 12

N. Y. Weather Bureau History

(*Continued from page 52*)

relatively unchanged exposure left in any large city in the United States.

In giving this brief sketch of the weather history of New York City, the writer has tried his best to make the account objective, but it is not easy to treat a subject of deep personal interest and not make at least one personal comment—or two. The first is an expression of regret, that limitations of space did not allow an account of the cooperative observers in and around New York City. Their voluntary and faithful work down through the years has added immeasurably to our knowledge of the climate of the metropolitan area. Finally, the writer wishes to call attention to a fundamental theme in the history of the local Weather Bureau Office. It showed itself when the Signal Corps privates struggled to the office through the Blizzard of '88. The writer has witnessed it during the hurricanes, snowstorms, and other critical weather situations of recent years, when everyone in the office gave his or her utmost under the leadership of Benjamin Parry and Ernest J. Christie. There was no thought of awards or medals, and none were received. But there was the thought of upholding a tradition, that of giving the best possible weather service to the nation's number one city.

Meteorology Education

(*Continued from page 62*)

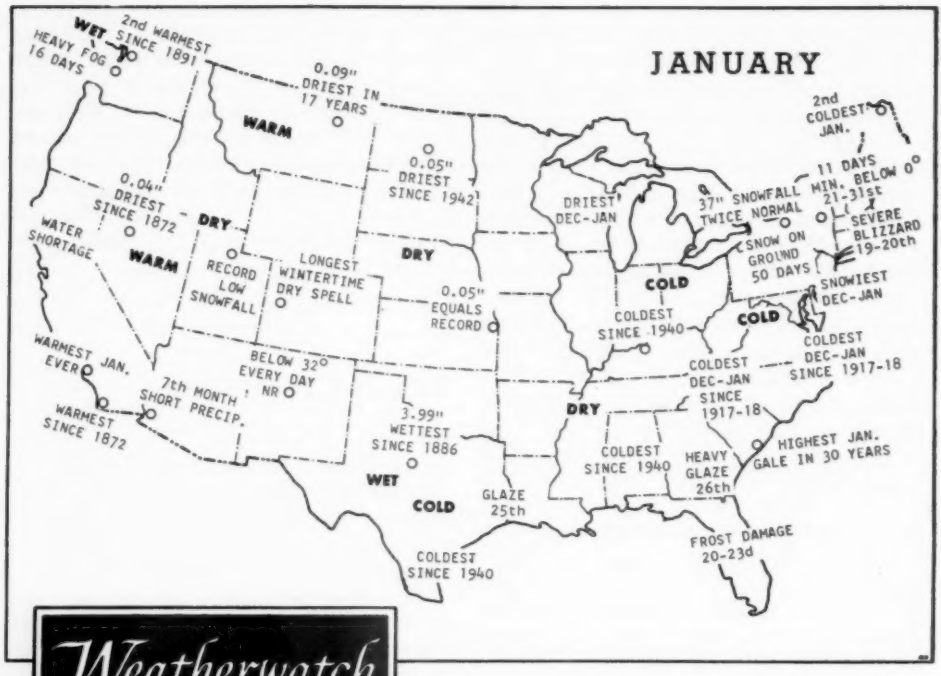
interpret their markings and symbols. In this way they learn to appreciate the contributions of the scientists in the weather bureaus to the vital operations of men in the air, on the land and on the sea.

Our elementary schools through the study of the science of weather are able to reduce superstitious beliefs that have come down through the ages and, in the process, have opened the eyes of children to a clearer understanding of weather, its causes and effects. In this way we are assuring for this city a scientifically literate population.

The General Science course in the junior high school reviews and extends the study of weather to a small extent. For talented and interested students, Earth Science is offered in grades 9 to 12. Approximately 30% of the course is devoted to an intensive study of the atmosphere and the movements of air masses and fronts. Since this course is taken by only approximately 10,000 in a school population of almost a million, the primary responsibility for the study of weather remains with our elementary schools.

The Science Bureau of the New York City Board of Education salutes Mr. Charles Knudsen, the new head of the U. S. Weather Bureau in our midst, as he takes over its operations in its new quarters in Rockefeller Center.

SAMUEL SCHENBERG
Director of Science
Board of Education
City of New York



Weatherwatch

Data by Office of Climatology, USWB.

Warm in West, Wintry in East

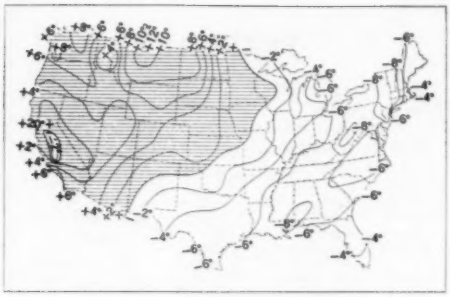
DAVID M. LUDLUM

January 1961, living up to its namesake's reputation, provided the nation with a Janus-faced meteorological month. During the first half the weather elements exposed a favorable mien and treated most of the country to a very mild January period, a welcome respite from the rough going during much of December. But soon after the 15th the month showed another guise by introducing a northerly stream and a severe cold spell that turned into one of record length. Some areas of the Northeast experienced their longest stretch of sub-freezing weather in modern times.

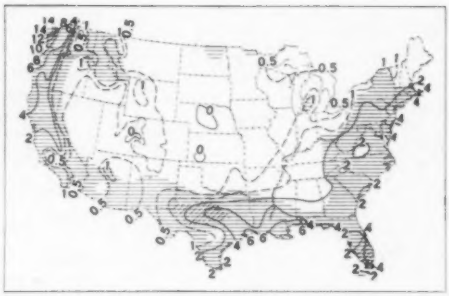
International Falls, in the heart of the continent astride the Minnesota–Ontario border, served as a checkpoint for the eastward penetration of Pacific air masses as well as for outbreaks of arctic air streams roaring southward. After a bitter first three days of January with minima of $-25°$, $-26°$, and $-30°$, the mercury at International Falls rebounded: a very mild 14 days ensued with the thermometer averaging 13 degrees above normal for a full two weeks and the maxima on several days reaching the 40's.

The southwesterly air control, however, broke down on the 17th with winds shifting to northwest and north. There followed a matching two weeks with the mercury reversing itself and averaging 15 degrees below normal. It was continuously below zero from the 21st through the 26th, with a nadir of $-35°$ on the 24th. From the 18th through the 30th the mercury did not top 9°.

A second feature of January's weather accompanied both the mild period and the cold period. An almost absolute drought held the vast reaches of the interior of the continent in its grip. From the Appalachians to the Sierras less than 25% of normal precipitation fell in these thirty days. Following on the heels of a very dry December, the water supply prospects in the Great Basin and Rocky Mountain areas took on grim forebodings. At Wendover AFB, Utah, the trace that fell on 31 January was the first rainfall of any type since December 4th. Bismarck in North Dakota had no measurable rainfall from 2 to 29 January, and the month's catch totaled a scant 0.05″, the driest 1st month since 1942 and the sixth driest in 90 years. Only in central Texas did rainfall prove excessive although most coastal areas were quite close to normal figures.



Departure of Average Temperature from normal in degrees Fahrenheit. USWB chart.



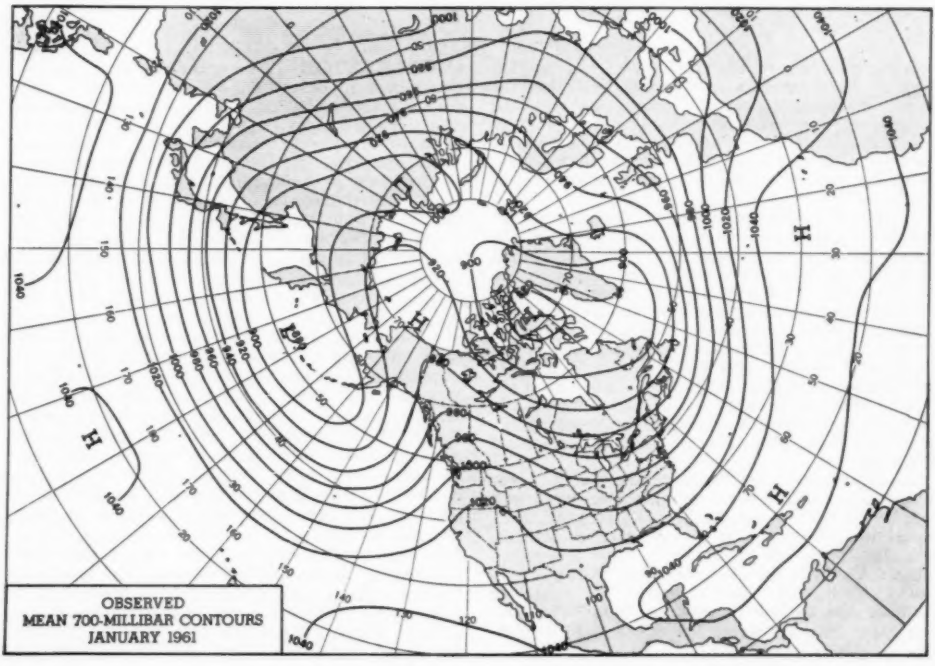
Total Precipitation in inches. USWB chart.

CIRCULATION—A Plateau high featured the weather maps of the first half of January. This represented a bulge inland of the Pacific High and permitted relatively mild polar air to flow into the continent over British Columbia and the Pacific Northwest states, to cross the Rocky Mountains as a dry wind, and then to descend onto the Prairies with chinook effect as double-dessicated air masses. At Bismarck, on the central North Dakota plains, the mercury went above freezing consistently each day from the 3rd to the 18th, with the single exception of the 8th. This circulation pattern represented a temporary high index of fast westerly flow, resulting from the rather tight pressure gradient between the Plateau high over the United States and a persistent low pressure trough latitudinally across central Canada.

From the 17th to the end of the month the circulation charts remained in an almost steady state. A massive ridge of high pressure covered all the Pacific Coast area with streamlines of air flow running from

(*Continued on page 77*)

The upper-air map below shows the pattern of air flow for January at about 10,000 feet, on which the average weather largely depends. The contours lines represent the mean height of the 700 mb. pressure level. Figures are in tens of feet: 1020 = 10,200 ft., 980 = 9,800 ft., etc. Chart by Extended Forecast Section, USWB.



Weatherwatch

Data by Office of Climatology, USWB.

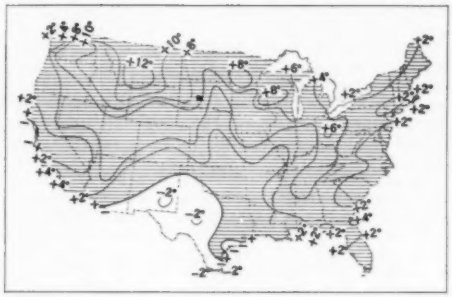
Westerly winds regained control of the weather scene in North America in early February after the period of complete northerly domination that had commenced with the great arctic intrusion of 18–19 January. Despite the overwhelming presence of mild air streams over all corners of the nation, February did manage to produce some notable weather headlines.

A great snowstorm sweeping the Northeast on 3–4 February created the greatest traffic chaos in the history of many large Eastern cities. Less than a week later another heavy snowstorm hit the southern portion of the Middle Atlantic States, but veered seaward before striking New York and New England again. During mid-month the mild, moist air streams from the Pacific doused the northern Pacific Coast with its first substantial rains in weeks. As precipitation totals in Oregon and northern California climbed toward record amounts, floods mounted and snow cover melted away—not in 60 years had there been so little snow pack in central California.

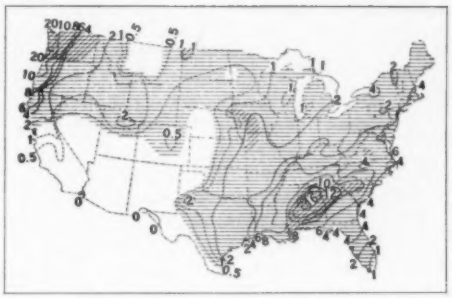
Texas, too, had very heavy downpours just after mid-month. As the wet area moved eastward into the Middle Gulf States during the last week, some places received as much as 17″ and rivers in Alabama and Mississippi hit flood stage with near-record crests. A shift in the main storm belt after the 15th was highlighted by the movement of the severe storm of the 24–25th through the Ohio Valley and Northeast, bringing record low barometers, destructive gales, and heavy snows.

CIRCULATION—The upper-air flow pattern commenced to change on 4–5 February as a very deep low (965mb/28.50″) off the Alaskan Panhandle coast moved inland through the upper Mackenzie basin to occupy the erstwhile home of January's arctic air masses. By the 8th the low had progressed all the way to Labrador, leaving a frontal zone across central Canada, to contain arctic air in the far North while westerlies rushed through southern Canada. The remainder of the month may be summed up as a struggle between the westerlies of the Pacific and the forces of the Arctic. For the greater part of the month the westerlies held the upper hand—there were only two arctic intrusions after the 10th, neither making very deep penetrations. The favored anticyclonic track led southeastward from the Canadian Northwest, between Lake Winnipeg and Hudson Bay, and then eastward across Quebec—so only the extreme Northeast of the United States lay in their paths and received only glancing blows from these threatened arctic invasions.

With the high index pattern well established by the 10th, the hemispheric charts of mean monthly pressure distribution showed two deeper than normal lows centered in their usual high index positions: in the Gulf of Alaska and off southeastern Greenland. Over continental United States a minor ridge-trough-ridge regime held forth, often exhibiting a rather flat contour pattern. After the 15th a strong westerly jet across southern Canada and northern United



Departure of Average Temperature from normal in degrees Fahrenheit. USWB chart.



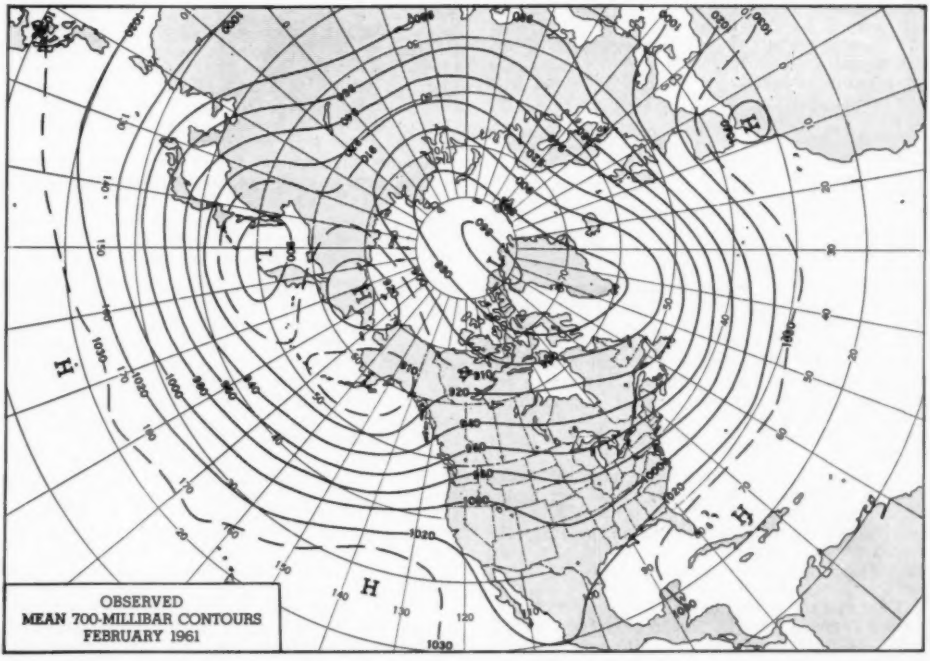
Total Precipitation in inches. USWB chart.

States carrying warm air to all parts of the country became the principal feature.

The main cyclonic action in the United States took place well south of the main jet as the maps featured cut-off low circulations, first over the Southwest and then over the lower Mississippi Valley and Gulf States. Heavy rains from Texas eastward, commencing on the 16th and continuing through the 23rd, dumped excessive rains to restore the ground water level in the Southeast which had been so seriously depleted by a long string of dry months.

During the closing days a peculiarly narrow trough in the upper air took form over the southern Plains and lower Mississippi Valley, and soon a marked surface low developed in the western Gulf of Mexico on the 24th and moved northeastward through the Tennessee and Ohio Valleys as the major storm of the month for a wide area along the Appalachian Mountain chain. Central pressure dropped below 970.2mb/28.75″ over central New York State early on the 26th. Along the western flank of the intense low, heavy snow fell in Kentucky and Indiana, stranding many people on a Saturday night. Gales force winds ripped through a wide area from the Carolinas northward to the lower Lakes and eastward through New England. To the north of the storm track a severe snow and ice storm sweeping down the St. Lawrence Valley gave Montreal its most crippling storm in years.

SNOWSTORM NO. 3—The third major snowstorm of the 1960–61 season in the Northeast swept



over the Middle Atlantic States and southern New England on 3–4 February. Few winters of the past can boast of three such disturbances; each covered the entire area from northern Virginia to eastern Massachusetts with massive falls, depths of 20″ and more being reported in all three. At the end of the third storm situation snow cover from northern New Jersey to eastern Massachusetts mounted to record levels.

The main ingredient in creating the early February storm was supplied by a massive area of high barometer that dominated southern Canada during the opening days of the month. Drifting leisurely eastward, it stood on the morning of the 3rd astride the Ontario–Quebec border with a central pressure at 1046mb/30.89″ and showed a tendency to hold its position and strength. Its core was made up of very cold air, with − 25° in central Quebec and − 11° at Caribou, Maine. Along its southern border temperatures had already dipped to zero on the morning of the 2nd as far south as New York and Philadelphia.

The presence of such cold air in a semi-stationary position soon had repercussions to the south where a low pressure situation developed a vigorous secondary off the Georgia coast on the night of the 2–3rd. By 1300/3rd, with the low center off southeastern North Carolina, light snow had broken out as far north as New Jersey, though it did not commence to accumulate until late afternoon. The northeastward progress of the snow shield proved exasperatingly slow to snow watchers, not reaching Providence or Nantucket with significant amounts until 0200/4th and Boston until 0400.

The northward progress of the center began to feel the resisting pressure of the Quebec high during the night of the 3–4th as it gradually made a turn to the east-northeast, moving eastward almost parallel to the southern New England coast, a course which permitted the circulation to bring vast quantities of Atlantic Ocean moisture from the southward and dump it as snowflakes on the land. Shortly after noon of the 4th, the center appeared about 100 miles south of Nantucket, moving slowly, with central pressure estimated at 996mb/29.41″ and gale force winds sweeping all the northern sector of the storm.

Snowfall was particularly heavy from central Pennsylvania and central New York eastward to Cape Cod. Concord, N.H., and Portland, Maine, were just on the northern border of the heavy falls—northern Vermont and New Hampshire had only slight amounts. The New York Metropolitan area, as in the Prewinter Storm of December, received near-record amounts: Newark had 22.6″ new snow with a cover of 25″ on the ground the morning of the 25th despite some settling; Central Park measured 17.4″ with 24″ on the ground; La Guardia Field 19″, and 26″ cover; Idlewild Airport 24″, and 22″ final cover. Considerable sleet was mixed with the snowfall in the early morning hours of the 4th when the circulation brought warmer east-northeast winds; this solidified the snow pack, reduced depths somewhat, but made the removal task even more difficult.

The heavy density of the snow mass prevented excessive drifting as had occurred in '88, but nevertheless created problems after the snow had become finer with falling temperatures late on the 4th. The peak wind at Central Park was 47 mph, a very respectable figure for a northeaster, and the fastest mile was above 30 mph for 15 consecutive hours at the Central Park anemometer. This combination of weather elements caused a major emergency in New York City. Mayor Wagner took the unprecedented action of banning all motor vehicle traffic in New York City with the exception of a very limited number of public services.

In southern New England similar conditions resulted. The storm totals at the major stations: Hartford 14.3″, Worcester 18.8″, Providence 18.3″, Nantucket 14.4″, and Boston 14.4″. At Providence, where records date back to 1904, this was the greatest single snowstorm, the most intense 24-hour fall, and snow on the ground reached the greatest depth ever measured—30″. At Worcester, just to the north in central Massachusetts, the snow cover mounted to 42″, a modern record for that locality.

CANADIAN HIGHLIGHTS

British Columbia. Coastal areas had more than twice the normal precipitation in February. Bear Creek on Vancouver Island reported in excess of 40″, and several cities and towns in southwestern British Columbia set new totals for the month. Vancouver had 25 days with measurable rain and new records of 15″ in the city and 11″ at the airport were established. Both Vancouver and Victoria experienced fewer hours of bright sunshine than any other February on record.

For the month as a whole, temperatures were two to four degrees above normal along the coast and more than eight degrees above in the southeastern interior. Several stations in the Vancouver-Victoria area reported the absence of any freezing temperatures, while on the other hand only the coastal areas and the southern interior valleys escaped sub-zero temperatures during the month.

Prairie Provinces. The month was mild with temperatures averaging eight degrees above normal. Towards the end of the first week, readings in excess of 60° were reported from several southern Alberta and Saskatchewan stations with 64° at Raymond, Alberta, being the maximum temperature in the country during the month. On 6 February, Dawson Creek, B.C., in the Peace River area set a new February record for that part of the country with a temperature of 60°. Ten days later, following an arctic outbreak, the mercury dropped to a minimum of − 41° at the same station.

Monthly precipitation values across the southern prairies were generally in the neighborhood of one inch. On February 22nd, Calgary experienced 12.5″ of snow in one day, a new February record, while during the last week of February from 12″ to 18″ fell over portions of southern Manitoba.

Ontario and Quebec. Extremely cold weather marked the first few days of February in Ontario. At some stations it was the coldest weather since 1948. After the end of the first week, however, temperatures were above normal on nearly every day and most of the area was from four to eight degrees above normal for the month. On February 24th, stations in the Windsor-Chatham area were reporting temperatures as high as 56° and 57°.

Precipitation amounts were near normal over southern Ontario and Quebec with major storms moving through the region on or about February 3, 15, 18, 23 and 26th. The storm of Sunday, February 26th, was one of the most severe ever experienced in the Montreal region where about three-quarters of an inch of freezing rain fell, followed by four inches of snow and accompanied by winds with gusts to 70 mph. Communications and utilities were severely crippled and transportation facilities dislocated. In northern Quebec, Knob Lake had an exceptionally

sunny and cold month with less snow than ever before reported in a winter month.

Atlantic Provinces. As the Atlantic seaboard storms moved eastward well to the south of the Atlantic Provinces during February, this southeastern corner of Canada had below normal temperature and precipitation during the month. When the temperature rose above 30° at Halifax on February 6th, it ended a spell of 18 consecutive days with below 30° values, the longest such cold spell since 1874. Although warmer temperatures were experienced during the remainder of the month, the whole area was below normal with some stations in Newfoundland averaging eight degrees below normal. In Nova Scotia, inshore fishing activities continued to be restricted by ice blocked Atlantic harbours as the sea temperatures dropped to unusually low values and even Halifax harbour experienced a skim of ice across it on several mornings. In Newfoundland it was the second coldest month on record at Gander where Gander Lake was reported frozen over the first time in a decade.

Because of the low temperatures, rainfall totals were extremely small throughout the area, and many stations in Newfoundland reported only a trace or nil. A major storm on 25–26 February spread freezing rain over southeastern New Brunswick and Prince Edward Island immobilizing all forms of transportation. At the same time, heavy rains in the southern Maritimes melted snow cover leading to local flooding. Precipitation in Labrador was less than 25% of normal.

The North. Both the eastern and western sections of the Canadian Arctic had temperatures from four to eight degrees below normal, while the central sections were more than four degrees above normal. The temperature at Resolute failed to go above − 9°F, while the lowest temperature in the country, − 54° was reported from Eureka. Precipitation was well below one inch throughout the whole area, with most areas reporting less than normal snowfall. Snow cover at the end of the month was in excess of 24″ in the Mackenzie Valley, less than 12″ on the far northwestern islands, and generally between 12″ and 24″ throughout the remainder of the north.

January (*Continued from page 73*)

the Arctic Ocean to the Gulf of Mexico. Low pressure generally occupied the Hudson Bay and Quebec area. This alignment brought constant reinforcements of fresh arctic air into southeastern Canada and eastern United States. The extensive snow cover over the region tended to increase the frigidity of air masses—on several mornings radiational cooling over central New York and Connecticut produced the coldest nightly temperatures registered anywhere in the country. In most places in the Northeast the mercury went below freezing on the afternoon of the 19th, to remain there for the duration of the month!

A broad-based, but deep trough over the Atlantic seaboard region constituted a prominent feature of all upper-air maps for this period. Here occurred the major cyclonic activity as lows formed in the Southeast and moved up the coast, usually offshore, to cross either Nova Scotia or Newfoundland. Each passage northeastward contributed to reinforcing the northerly flow over the Atlantic States where the coldest weather since February 1943 followed.

The Pacific air masses gave some moderate rainfalls to the coastal areas, but their passage over the Great Divide relieved them of all precipitable moisture. For the two weeks ending on the 16th, no measurable rainfall fell over a wide area of western United States and southwestern Canada. The mild, dry conditions prevailing over all the West then extended to almost the entire nation at mid-month. Temperatures climbed to unusual mid-winter levels: Rapid City, S. D., 60° on the 16th and Chicago 51° on the 13th and 48° on the 17th.

Cyclonic activity during the first period had been confined mainly to Canada. On the 14th, however, a significant shift in the scene of storm genesis took place as the first of a series of disturbances developed in the western Gulf of Mexico and moved northeastward to produce a snow shield over the Middle Atlantic states.

A northward extension of the Plateau high became evident on the 17th and this was to change the circulation pattern of all North America. The expanded western ridge aloft immediately shut off the air streams from the Gulf of Alaska. The way was then open for arctic air to rush southeastward to penetrate all the way to the Gulf and South Atlantic coasts. As the major cold front advanced southward over the Plains, a small and rather innocuous looking wave appeared and was forced directly eastward along the periphery of the arctic air mass as a blocking ridge built eastward quickly across southern Canada and New England. Once Atlantic Ocean air entered the circulation of the small low as it crossed southern Virginia, the storm center intensified markedly, and the now historic Kennedy Inaugural Storm was on.

THE KENNEDY INAUGURAL STORM—Forecasters at the Nation's Capital early on the morning of January 19th had their thoughts centered on a small low pressure area moving eastward across the northern part of Tennessee. Up to this time the disturbance had produced only a small precipitation shield of light snow, with the heaviest amounts merely .05″ in the central Ohio Valley. Its future course and behavior, however, were of great importance since the extensive Kennedy inaugural ceremonies, indoors and out, were scheduled to commence at noon the next day.

By early afternoon of the 19th, with the center now astride the Tennessee-Virginia border and pressure down to 1000mb/29.53″, light snow had broken out as far north and east as New York City. At this time there was some evidence on the Virginia coast of the formation of a new center directly east of the original low. The presence of low pressure across the state of Virginia encouraged a flow of moist Gulf and Atlantic air from the south up and over the cold air mass lying to the north. This supplied the moisture to turn the light snow into moderate and heavy falls late in the afternoon, just at the time when thousands of election celebrants were converging on Washington. Snowfall there commenced about noon, fell heavily from 1400 to 2300, then tapered off to very light for the rest of the night, ending at 0600/20th. A total of 7.7″ was measured at the National Airport.

The circulation of the developing storm brought both more moisture from the south and more cold from the north, resulting in a major snowstorm over the Northeast. Snow commenced at Albany with the mercury at 2°, and at New York City thermometers clung close to 20° during the period of heavy snow. The clash of cold and warm air masses deepened the low center on the evening and night of the 19–20th—down to 984mb/29.06″ off southern

Maryland, and to 968mb/28.59″ twelve hours later when east of Nantucket. The storm's intensity may be attested by the Nantucket report: a low pressure of 28.85″, an average wind speed of 30 mph from east-northeast, and a peak one-minute sustained speed of 48 mph. Sixteen inches of snow fell there in the 24 hours commencing at 2000/19th. Considerable flooding resulted in Nantucket harbor from a tide 4.5 feet above normal.

The storm, true to the 1960–61 tradition, turned into a good snow producer. The band of heaviest falls formed a familiar arc from western Maryland to eastern Massachusetts, fortunately inland from the largest industrial cities, though many of these received a 10-inch covering. The preliminary top figures for the region were: Maryland 16″, Pennsylvania 19″, New Jersey 26″, New York 24″, Connecticut 25″, Massachusetts 24″, and New Hampshire 25″.

The snow proved a drifter and virtually snowbound the entire Northeast on Friday morning. Fortunately, the combination of unplowed roads and the approaching weekend caused many to abandon all idea of going to work, thus providing a much larger than normal audience to watch the inaugural proceedings from Washington. Only a herculean, all-night effort by the snow removal forces, augmented by Army equipment, cleaned Pennsylvania Avenue bare so the parade went on as scheduled under a sunny, but chilly sky.

British Columbia. For the first half of the month January was marked by a series of active Pacific storms, but in association with the development of a strong ridge of high pressure in the mild Pacific air, very settled weather occurred during the second half. It was a month with heavy precipitation as Seymour Falls north of Vancouver reported 41.10 inches. Other national extremes in B.C. during January 1961 were—(1) a temperature of 64° at Hollyburn Ridge also near Vancouver; (2) mean daily temperature of 45° for the month at stations on outer Vancouver Island, and (3) a small area near Victoria where the temperature did not drop below 32° during the month. Vancouver had a long period of dense fog during the last half of the month which snarled transportation, while at mid-month severe floods in the Fraser Canyon washed out most trans-continental communication routes for several days.

Prairie Provinces. During the first three weeks of the month, storms moving in from the Pacific forced mild air over the Rockies giving chinook conditions in southern Alberta and mild dry conditions across the remainder of the southern Prairies. This was one of the mildest Januarys in recent years in southern Alberta, while in southern Manitoba extremely cold conditions during the last two weeks produced a month which averaged near normal. In the Prairie Provinces the temperature extremes ranged from 60° at Lyndon, Alberta, to −49° at Brochet, Manitoba.

Snowfall was everywhere light averaging from 3 to 8 inches. Most stations in southern Alberta and Manitoba had only between 25 and 50 per cent of normal precipitation. The monthly total at Winnipeg was 0.11 inch making it the driest January on record. Southern Alberta was snow free for most of the month allowing a general dust storm to develop near Calgary on 27 January.

Ontario & Quebec. It was a cold and dry month throughout southern Ontario and Quebec. While the first half of the month averaged near normal, extremely cold weather was experienced during the last two weeks. In southern Ontario the temperature failed to reach as high as 25° from the 19th to the end of the month, and sub-zero temperatures were reported from every station on at least one day. Rainfall was extremely sparse and snowfall amounts were considerably below normal even in those areas in the lee of the Great Lakes. At Toronto, Malton Airport reported the lowest precipitation for any January on record; while Montreal experienced the longest cold spell on record in the last twenty years.

Atlantic Provinces. During the last fourteen days of the month, biting cold gripped this district and gave sub-zero temperatures every day. By month's end normally ice-free harbors along the Nova Scotia coast were freezing over. At Halifax the closing thirteen days of the month did not bring a single thermometer reading over twenty-five degrees; the first time that so long a consecutive string had occurred in the 88 years of record. Halifax also experienced its tenth consecutive month of sub-normal precipitation and above normal sunshine, although several storms affected the area during the month. On 20 January, one of the most severe storms on record struck the Moncton region of New Brunswick, producing 15 inches of snow accompanied by 40 mph winds with gusts to 65 and temperature readings near zero. This storm also produced gust speeds of 97 mph at St. John's Torbay Airport in Newfoundland.

The North. When arctic air was dammed over the lower Mackenzie Basin during the first half of the month, temperatures were much below normal but during the second half marked warming occurred. As a result most of northwestern Canada ended the month with above normal temperatures while the northeastern Arctic was 4 to 6 degrees below normal. Eureka was again the coldest location in the nation with an average temperature of −36°, an extreme low of −57°, and a maximum temperature of −16°. Snowfall amounts were generally less than 5 inches throughout the Arctic except in the Great Slave area where they totaled more than 10 inches.

N. Y. Weather Highlights

(*Continued from page 67*)

In 1835 the famous New Brunswick tornado crossed the lower part of Staten Island and into New York Bay on 19 June. No damage or casualities were reported in the city or harbor, but ice-covered shingles and mixed debris were seen to fall into the Hudson River opposite Manhattan that afternoon, presumably from the New Jersey storm.

A severe storm struck the city late on the afternoon of 13 July 1859. Though described by contemporary writers as a tornado and so classified by John Finley, the early Signal Corps authority on the subject, evidence points to this being a severe line squall attending a cold front passage. The *New York Tribune* noted at 1730 "a perfect tornado of wind and rain, uprooting trees, tearing off shutters, signs, chimneys, and with the

roaring of rain which seemed almost a solid body of water, the incessant glare of the fierest chain lightning, and the crashing of thunder, made a scene of the most magnificent but terrible description." A similar line squall hit the city on 11 June 1922 when the June record of 72 mph from the northwest was set.

Information is at hand that a bona fide tornado occurred in Brooklyn at the unseasonable period of 9 January 1889 and in Harlem a tornado or near-tornado took place on 25 June 1898. Apparently there was something in the air during the gay-nineties conducive to small tornado formation.

AN INTENSE COLD SPELL

The great cold wave at the turn of the year, 1917–18, has never been equaled for persistence of low readings. Commencing on 29 December, the following early morning minima were registered at Central Park: − 6°, − 13°, − 7°, − 4°, + 2°, 0°, and − 3°. On the coldest day, December 30th, the mercury moved above zero only at the 1400, 1500, and 1600 observations—the maximum was + 2° and the mean for the 24 hours − 5.5°.

The maxima at Central Park on the 29–31st were + 3°, + 2°, and + 5°. From late on the 28th until the afternoon of the 4th, the mercury did not exceed + 15°. It was not until the 6th that it rose above freezing. After this frigid start the coldest January in modern history followed.

THE ALL-TIME LOW

Thermometers on the morning of 9 February 1934 sank to the lowest point ever reached on Manhattan Island in Weather Bureau history: − 15° at Central Park and − 14.3° at the Battery. The only other day since 1871 with a reading of this degree of severity occurred on 30 December 1917 with − 13° at both stations. This coldness appears to be about the absolute for the New York area, at least for the almost 200 years of instrumental records. Comparable readings (− 10° or below) were also reached in 1780, 1821, 1857, 1859, and 1866. A diary reference to − 16 on 29 January 1780 is the lowest noticed by this writer.

The mercury at Central Park dipped below zero on three consecutive mornings in February 1934: − 7° on the 8th, − 15° on the 9th, and − 2° on the 10th. It was below zero for 15 consecutive hours on the 8–9th. Other low readings in the region were: New Jersey—Canoe Brook, Morris Co., − 26°; New York—Carmel, Putnam Co., − 24°; and Connecticut—Cream Hill, Litchfield Co., − 26°.

February 1934 also averaged out the coldest calendar month in Weather Bureau history—its 19.9 degrees at Central Park and 19.4° at the Battery erased the former lowest of 21.7° set in January 1918. Records for the Nineteenth Century at nearby localities show that January 1857 with 19.6° is the only other month that can boast of a monthly average lower than 20 degrees.

THE ALL-TIME HIGH

New York's most scorching day came on 9 July 1936. A four-day heat wave reached its peak on the 9th when the mercury hit 100° at 1200, 104° at 1400, and 106° at 1600. With the mercury still reading 103° at 1800, a west wind sprang up and brought a temporary cooling to 94° an hour later and to 78° by midnight. Next day, however, the mercury soared to 102° at 1300 for two century days in a row. Readings in the suburbs were close to the Central Park mark, but only Plainfield in New Jersey reached the extreme 106°.

Another notable hot day in New York occurred on 7 August 1918 when Central Park had a maximum of 104° and a minimum of 82°. Down at the Battery it climbed to 102° that day. Readings in excess of one hundred degrees have been recorded in every warm season month; the top figures at Central Park are: June 1934 101°, July 1936 106°, August 1918 104°, and September 1953 102°.

In the Nineteenth Century 100-degree readings were a rarity, probably as a result of the exposure of thermometer shelters on a north wall of a building and to the greater amount of trees, woodland, and foliage surrounding thermometer exposures in those days. The Newark record from 1843 reached 99.75° in July 1849, but did not top the hundred figure until September 1881 with 100.5°. Union Hall in Jamaica from 1826 to 1864 had only two such readings in its history: July 1830 and 1856.

Climatological Publications for New York

1. *Local Climatological Data,* monthly and annual, for the New York Meteorological Observatory (Central Park), La Guardia Field, and N. Y. International Airport. Daily data with month's totals and averages.
   Local Climatological Data Supplement, monthly, for La Guardia Field and N. Y. International Airport. Hourly and frequency data.
2. *Local Climatological Data,* monthly and annual, with supplements, for Newark, N. J. The prices of the foregoing are $1.00 per year, including the annual summary; $1.00 per year for monthly Supplements only; $1.50 per year for monthly summary, monthly supplement and annual summary. Single copy prices are: 10 cents for monthly summary, 10 cents for monthly supplement, and 15 cents for annual summary.
3. *Climatological Data—New York.* A monthly publication, with annual summary, giving mainly the once-daily temperature and precipitation observations (with snowfall in season), taken at the cooperative observing stations in New York State. A number of these stations are located in and around New York City.
   Climatological Data—New Jersey and *Climatological Data—New England* include stations in the suburban areas of New Jersey and Connecticut. 20 cents per copy, monthly and annual, $2.50 per year, for each State.
4. *Climates of the States—New York.* Same for New Jersey and for New England. Tables, maps and text on the main features of the climate, covering the New York metropolitan area. 15 cents each.
5. *Climatic Guide for New York City, New York, and Nearby Areas.* Most up-to-date and comprehensive source of information on the local climate. 40 cents.

The above may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Checks and money orders should be made payable to the Superintendent of Documents.

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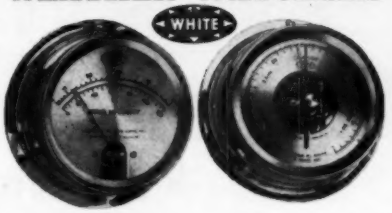

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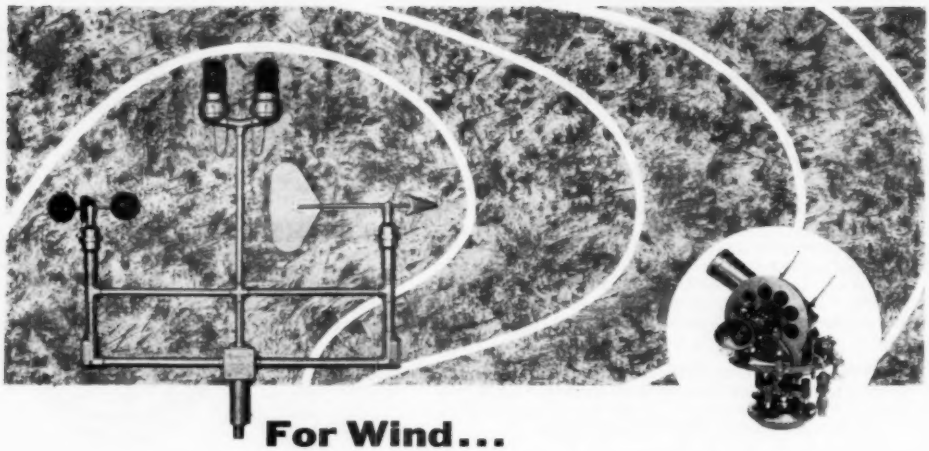

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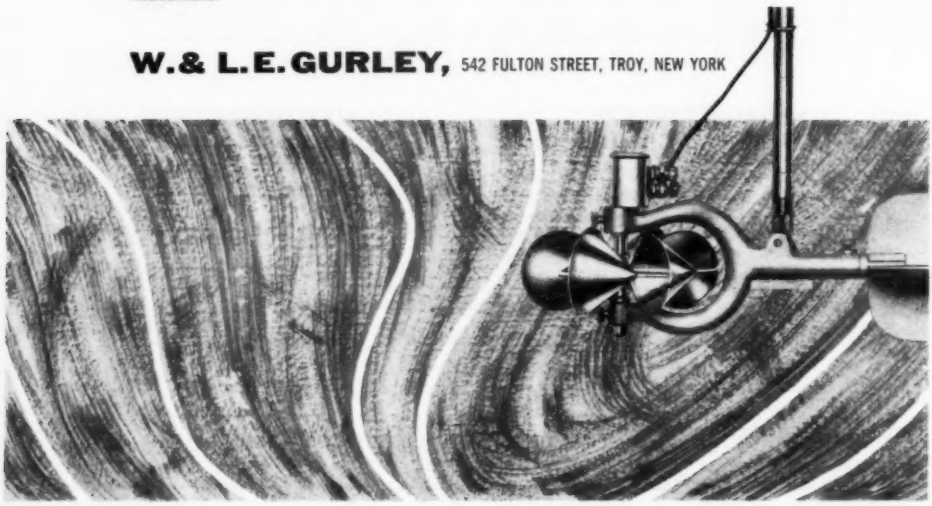

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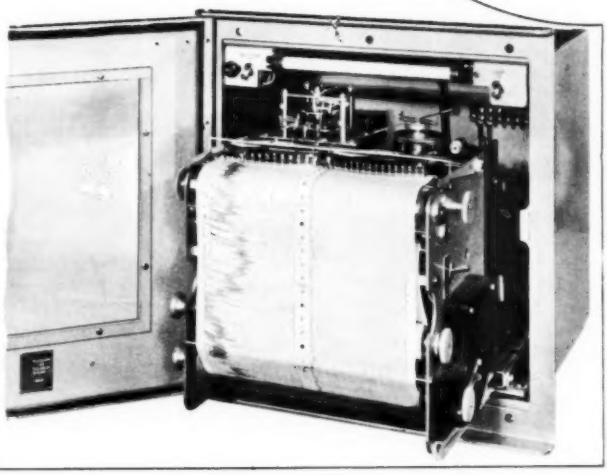

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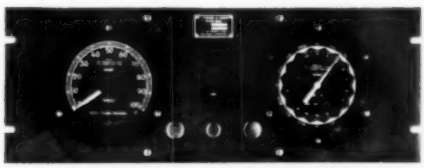

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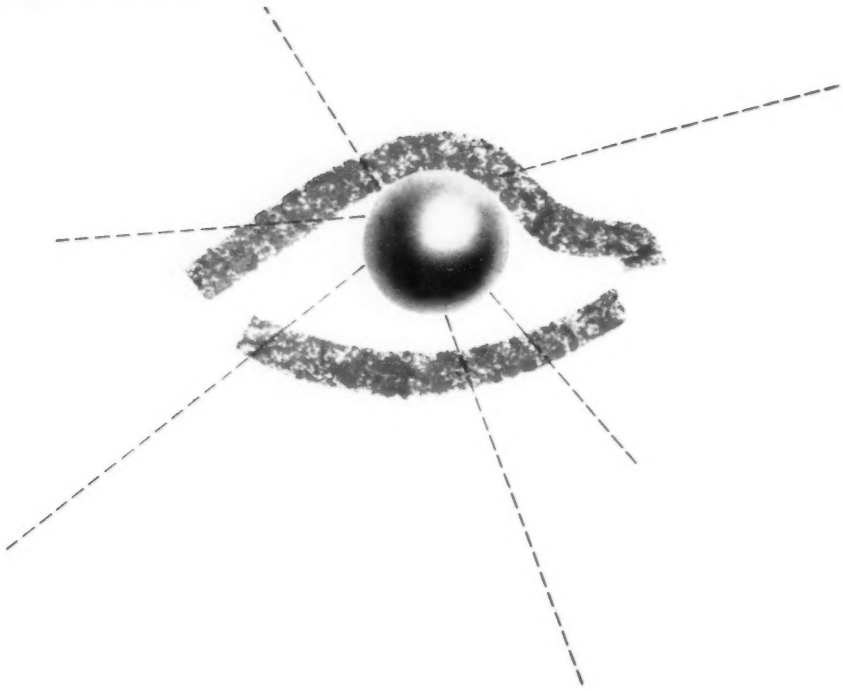

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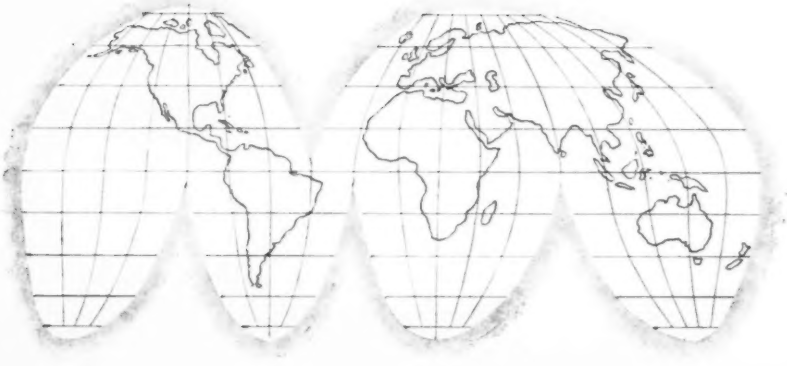
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